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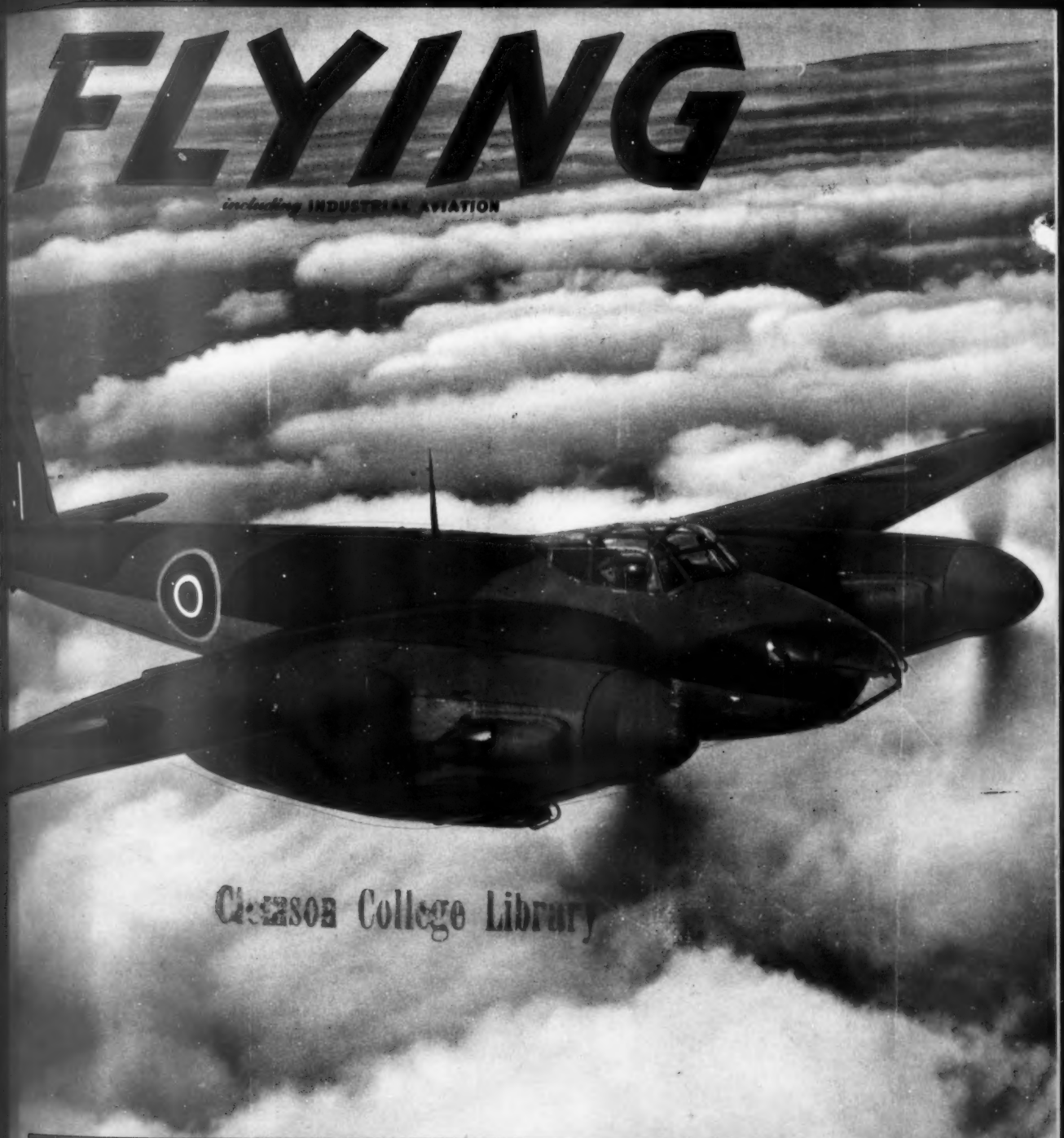

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THE STORY OF WILLOW RUN

LIGHTNINGS IN AFRICA

By Capt. William J. Hoelle

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Turn on the sunshine in
home. Arrange to take care of some
worker's children. That's a real contr
tion that any woman can enjoy ma
to the war effort. Just get in touch
your neighborhood O.C.D. Block W
er. She'll be glad to arrange everyth

Yoo Hoo, Mr. Rand! You Too, Mr. McNally! Th
maps of yours are really going to mean something to Mr. and
America when this war's over. What used to be an all-day drive
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That's why the end of this war will see the start of a whole new wo
of travel, adventure and fun for you in your own Family Car of the

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Here is what recent Parks Air College graduates are doing today—serving in the Armed Forces and serving their country in air transport, aircraft production, and in training activity.

These men—153 of them—on whom information was available, all completed their Parks training between America's entry into the war and December 20, 1942.

16 are in the United States Armed Forces — 8 as commissioned flight officers or aviation cadets in the Navy, 1 a Naval Ensign, 5 commissioned flight officers or aviation cadets in the Army Air Forces, 2 in the Marine Corps.

41 are in Commercial Air Transport—14 with Transcontinental and Western Air, 1 with Eastern Air Lines, 16 with American Export Airlines, 1 with Pan American Airways, 8 with Northwest Airlines, and 1 with the Air Service Command.

17 are in U. S. Army Air Forces training activity in the five Parks Air College organizations.

79 are in airplane, airplane engine, and accessory manufacturing and servicing—1 with General Electric, 1 with Pratt & Whitney, 2 with Vultee Aircraft, 13 with Wright Aeronautical Corporation, the majority as field service engineers in foreign service, 25 with Curtiss-Wright, 4 with Ford at the Willow Run bomber plant, 5 with Glenn Martin, 1 with Consolidated, 19 with Vought-Sikorsky, 2 with Lockheed, 1 with Noorduyn, 2 with Culver, 1 with Fairchild, 1 with Boeing, 1 with Rearwin.

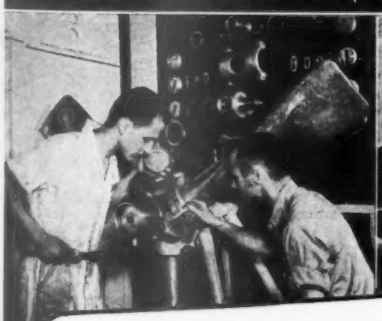
All of these men prepared themselves at Parks to be of exceptional value in the war effort. All are serving their country in various aviation activities—in actual combat flying and in the design, production, and maintenance of aircraft.

Because of the thoroughness of the training they received at Parks, they are not only engaged in this valuable service now, but have laid their groundwork for a successful career in aviation after the war is won. They realized that the ability to fly is not enough on which to base a peacetime career, but that Parks Leadership Training, Parks well-rounded education would equip them for future success.

Every branch of aviation is of dominating importance to your country today. As a wartime measure, Parks now is admitting students who have completed but 3½ years of their high school work, providing certain conditions are met.

But don't delay. Make the most of your next two years by taking advantage of the educational opportunities offered by Parks Air College. The coupon or a post card request will bring you the new, free, 64-page Parks catalog with complete information. Send for it *now*.

PARKS AIR COLLEGE, East St. Louis, Ill.



PARKS AIR COLLEGE was founded August 1, 1927. Has enjoyed full Federal approval longer than any other aviation school.

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Has a capacity enrollment of 300 commercial aviation students, also detachments of U. S. A. Air Forces Aviation Cadets and Mechanics.

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FLYING

including **INDUSTRIAL AVIATION**

VOLUME XXXII NUMBER 5

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Cover Photograph: De Havilland "Mosquito," by Charles E. Brown

★ ★ ★ ★ ★

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WAR SERVICE AVIATION CAREER

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Conscription includes everyone 18 years old or over. Closing of enlistments has put a stop to choosing service. You will now be assigned. YOUR BEST CHANCE IN AVIATION NOW IS TO TRAIN FOR IT . . . making yourself the kind of man the Air Forces want: the kind they can't do without. If you are thoroughly trained you will advance rapidly in the Army Air Forces or in Civilian aviation.

Curtiss-Wright Technical Institute is training hundreds of civilians in aviation mechanics and aeronautical engineering. These men will be definitely qualified for their place in aviation, either military or civil.

By enrolling at Curtiss-Wright Tec now, you have an enviable opportunity to guide your own future. HIT THE BULL'S EYE WITH BOTH BARRELS AT ONCE . . . one for your war service, the other for your after-the-war career in aviation.

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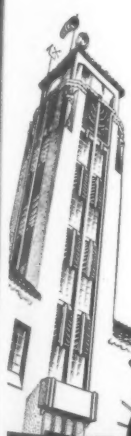

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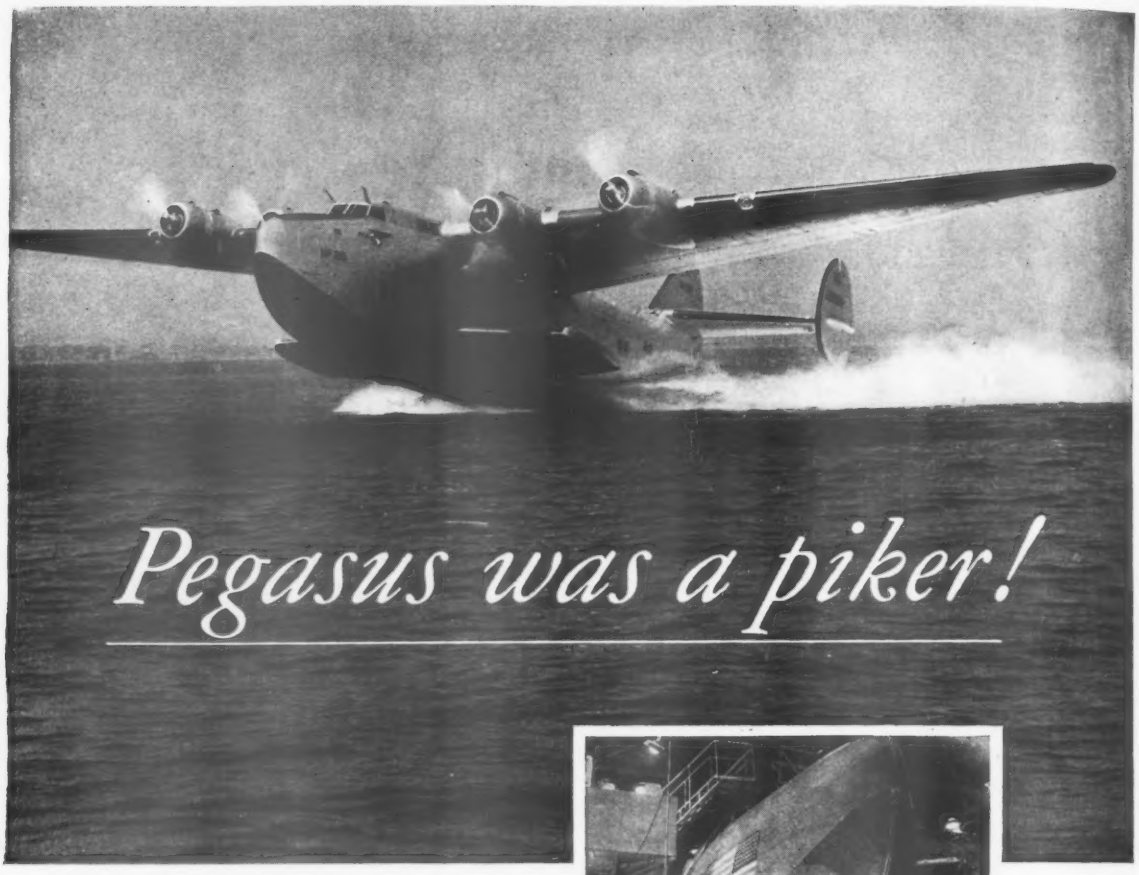
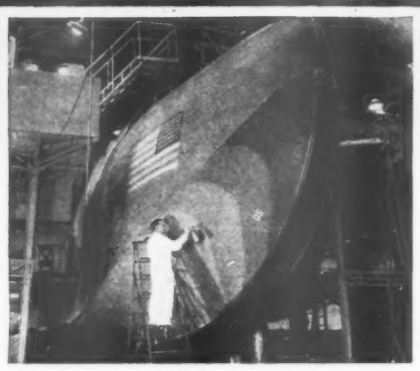


Pegasus was a piker!



• Not even in the wildest flights of fancy does the winged horse of mythology compare to the everyday miracles performed by the great flying boats of Pan American Airways.

But Pegasus had one advantage! He didn't have to fret over the problems of supplies, parts, repairs and the myriad details of maintenance that make Pan American's world-wide operations all the more remarkable in their amazing efficiency.

Valspar is quite proud of the fact that this far-flung airways system uses certain Valspar Val-Aero finishes at its bases in New York, Miami and Rio de Janeiro.

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The devastating bombing power and matchless fighting power of the Boeing Flying Fortress make comforting daily items in the war news. Much of the flying power for this invincible dreadnaught of the skies comes from Studebaker, long regarded as one of the world's foremost builders of motor car engines.

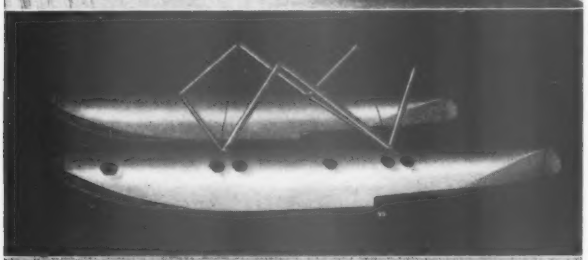
Studebaker, America's oldest manufacturer of highway transportation, is privileged to collaborate with Wright, America's oldest producer of airplane engines, in this vital assignment. And Studebaker is also building much other war matériel including tens of thousands of big, multiple-drive military trucks for the forces of the United Nations.

Today, as for generations past, Studebaker craftsmen make their watchword—*"give more than you promise."* Every Studebaker employee is justly proud of the achievements of his organization in the arming of our Nation and its Allies.

BUY U. S. WAR BONDS

War Trucks for the United Nations! Studebaker, famed for years for dependable transportation, has now become one of the largest producers of big, multiple-drive military trucks for the forces of the United Nations.

Studebaker BUILDS WRIGHT CYCLONE ENGINES FOR THE *Flying Fortress*



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HEATH PLASTIC-BONDED PLYWOOD SKIS
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"Plywood in aviation" is a popular topic today. But yesterday – before the advantages of this versatile material were widely known – Heath Floats and Skis had passed the experimental stage and had proven plastic-bonded plywood to be a superior aircraft material. And Heath engineering continues its work with plywood – forming it into intricate curves and shapes adaptable to other aircraft components . . . . The possibilities in plywood are amazing and Heath is prepared to expand its use in solving further problems. Your inquiries are invited. Write us today.

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BENTON HARBOR Company ★ MICHIGAN, U.S.A.

AT DEADLINE

by MAX KARANT

BRITISH fears that American air transport will dominate the world's commercial aviation structure are more British self-criticism than anything else. A few anti-Americans would like to make it appear that our aviation men are subtly building up a world network with the suppression of all other commercial aviation as a major objective. Most men in the British aviation industry, however, hold the policies of their government to be at fault.

American cargo and transport aircraft are admitted to be the finest of their kind in the world. The British themselves want every single American transport they can get. They say so quite frankly. The simple reason is that there is not the modern type of aircraft in this category built anywhere except in the United States.

If American air transport lines *do* dominate those of all other nations after the war, it will be because the whole gigantic net work was forced upon us; it was either establish the routes or the United Nations would lose the war. Few—if any—U. S. airlines visualized long-range landplane operations over all the oceans to every continent and climate on earth. Most pilots flying these routes even today find it hard to believe that it can be done.

We simply had no choice. British air transport services, for instance, were not sufficient to carry the load—and even those services were being operated with American aircraft. To our knowledge, there isn't a single modern British, Russian or even German air transport plane in production today. There are several American types being produced by the thousands—in addition to all other U. S. aircraft production.

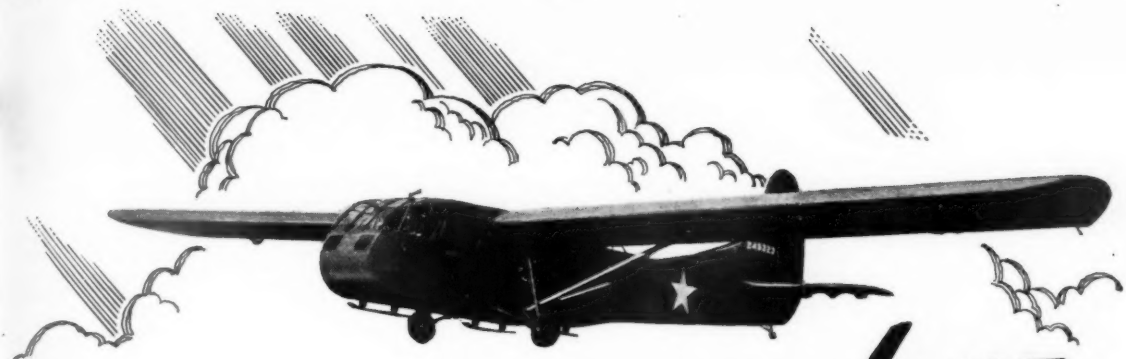
* * *

IN WASHINGTON the other day we made our routine check into the aircraft recognition program being taught throughout the country. We were treated to an unusual, pleasant surprise. An Army and Navy officer, each of whom we visited separately, confided in us that their respective services now feel that the British method of assembling and teaching aircraft recognition is "the finest there is." We were almost bowled over. It was only a few months ago when the same men sneered at us when we suggested that the terrible muddle over the subject (which still exists, incidentally) might be overcome if our people would simply and frankly adopt the British system in toto. We were told bluntly that our people had plenty of ideas that would put the old methods to shame. That was some time ago; it was only very recently that these men admitted—finally—that the British had something there.

Meanwhile, the teaching of aircraft recognition in the United States probably has been the most mishandled of all required ground school subjects. Not only have we *not* had the proper materials or system, but the great majority of teachers have been wholly ignorant of the subject. Army and Navy instructors even today are teaching this vitally important subject with newspaper and magazine clippings. There is a flood of so-called "spotters' handbooks" on the market in this country, but we haven't seen one that was worth the paper on which it was printed. The little booklets produced by The Aeroplane in London are considered — unofficially — to be the "bibles" of aircraft recognition in this country. However it is practically impossible to buy the booklets over here.

The editors of FLYING have spent a good deal of time and money trying to produce recognition materials approaching the excellence of those of The Aeroplane. The slide film kit we devised some time ago—based on the British system—now is in use in more than 100 Army, Navy, and civilian schools in the United States. But those kits have been purchased out of miscellaneous funds of each school; the Army and Navy still, after more than a year of war, are supplying their schools with makeshift, inaccurate materials. Not long ago we saw one of the expensive sets of glass slides being used by one of our armed forces to train its flight crews. We were

(*Continued on page* 169)



RE-PRODUCTION LINE 2500 MILES LONG

all hatched from the same nest . . .

Look at the map of America. Look at Michigan, Ohio or California . . . at Pennsylvania, Indiana or Tennessee . . . but wherever you look you'll see some part of the far-flung production line which is turning out WACO 9- and 15-place, troop-carrying gliders for the Army Air Corps.

It's a strange sort of production line . . . not at all like the vast, under-one-roof affairs in the newsreels. There wasn't time for that because the Army wanted gliders—NOW! No, it's a lot of plants in a lot of places . . . fifteen other aircraft plants plus scores of others which are supplying parts or sub-assemblies. But, today, wherever they are and whatever they were, they're all a part of the same production line . . . all working from the same blue-prints.

These blue-prints came from the drawing boards of WACO engineers . . . and from these blue-prints are now emerging the gliders which may one day soon carry the hard hitting air-borne infantry over and behind every fighting front. The news communiques probably will refer to them merely as CG-3A and CG-4A gliders. But we'll always know them as WACO gliders because they'll all be of WACO design . . . all hatched from the same nest. THE WACO AIRCRAFT COMPANY, Troy, Ohio.

Glider Photographs, Courtesy Timm Aircraft Corp.

The Birdmen's Perch

WE HEARD a story the other day that sent us right out to buy an *extra* War Bond.

Friend of ours was at one of those get-togethers where our military fighters and our factory fighters compare notes and swap information on the performance of that particular factory's product at the front.

One chap on the speaker's stand kept reaching for the pitcher of ice water, gulping glass after glass. Our friend finally leaned over and asked the lad if he was ill.

Turned out he'd been with Rick on the Pacific and he "couldn't bear to see cold, fresh water without drinking it."

We thought that story over a while —and thought over a lot of the stories we've heard from and about our service men... and we whizzed out and bought that extra War Bond.

Major Al Williams,
alias, "Tattered Wing Tips,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

BRAINTWISTER

At an airspeed of 100 mph, how long would it take to make a round trip from A to B, and what would your average groundspeed be? The answer is *not* 2 hours and 100 mph!

Robert Harvey, of Fresno, Cal., sent this in, and it's one of the nastiest puzzles we ever lost a night's sleep over. We'll send you the answer as soon as you write.

OILS ARE DIFFERENT, TOO!

To the casual eye, there's not a great deal of difference between a Jap Zero and one of our P-40's. They've different noses of course, but by and large, they've got pretty much the same span, overall length, etc.

But a P-40 can take about 6 times as much punishment as any Zero that ever flew! Because there's no corner-cutting in the manufacturing of a P-40. There's no sacrifice of quality for the sake of quantity—*the plane is the finest aircraft the maker knows how to build.*

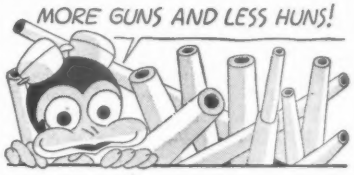
Oils may seem pretty much alike, too. But there's one called Gulfpride that knows no sacrifice of quality for the sake of quantity!

There's no corner-cutting in the refining of Gulfpride. Not only is it refined by conventional methods, but also by Gulf's famous Alchlor Process which gets more of the harmful carbon-makers and sludge-formers out of Gulfpride. *Gulfpride is the finest aircraft-engine lubricant that Gulf knows how to refine.*

NO CRACKS, NOW...

A machine-gun manufacturer had difficulty in heat-treating certain of the steel gun parts. When the steel was quenched (cooled quickly from red-heat to impart hardness) in water, the water cooled the steel too fast, causing cracks and distortion. But when ordinary quenching oil was used, the necessary degree of hardness could not be obtained. The manufacturer tried Gulf Super-Quench, a revolutionary new kind of quenching oil which figuratively "shifts gears," cooling quickly at first and then more slowly as the temperature of the metal drops.

He got the exact degree of hardness he wanted in the gun parts! He got it without cracking or distortion . . . and, by eliminating rejects, he got increased production of badly needed machine guns!



Gulf Oil Corporation and Gulf Refining Company... makers of

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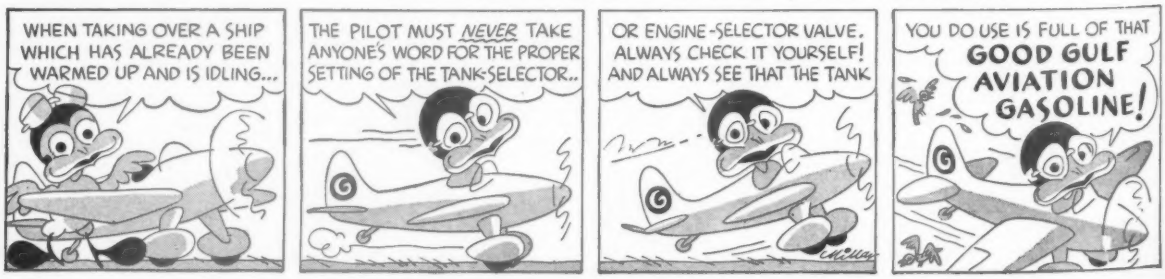
WHEN TAKING OVER A SHIP WHICH HAS ALREADY BEEN WARMED UP AND IS IDLING...
THE PILOT MUST NEVER TAKE ANYONE'S WORD FOR THE PROPER SETTING OF THE TANK-SELECTOR..
OR ENGINE-SELECTOR VALVE. ALWAYS CHECK IT YOURSELF! AND ALWAYS SEE THAT THE TANK
YOU DO USE IS FULL OF THAT GOOD GULF AVIATION GASOLINE!

WHEREVER THEY FLY FOR FREEDOM !

SPARTAN SCHOOL OF AERONAUTICS

This "University of Aviation," operated as a division of the Spartan Aircraft Company, is marked as one of the outstanding civil aviation schools in America . . . is recognized for its unexcelled training of thousands of skilled aircraft technicians who are now serving American aviation . . . is depended upon by the industry for a continued supply of such valuable men.

Around the world American airmen strike for victory. From Iceland to Australia, from the Aleutians to the Congo, our gallant air force thunders on. As a member of this nation's great aircraft industry, and as contractor to the U. S. Army and Navy, SPARTAN is proud to help furnish the equipment needed by our fighters of the sky.

Today's foremost weapon of destruction will be tomorrow's means of closer world relationship. Great air fleets will literally gird the globe as America sets the pace in the gigantic peace-time aviation industry of the world. Then will SPARTAN again build fine aircraft for the commercial market. Until then, we work only for those who fly for freedom.

SPARTAN AIRCRAFT CO.

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CONTRACTOR TO THE U. S. ARMY AND NAVY ★ BUILDERS OF FINE AIRCRAFT SINCE 1929

Trail Blazing in the Skies

1920

THE FIRST BULLET-PUNCTURE-SEALING GASOLINE TANK for military airplanes was developed by Goodyear at the close of World War I. After exhaustive tests it was adopted by the Army Air Corps and Goodyear was officially commended in 1920 for its invention. That is a matter of record, as was its effectiveness in sealing punctures made by the small-caliber armament then carried by planes.

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1. *By building parts to manufacturers' specifications.*

2. *By designing parts for all types of planes.*

3. *By re-engineering parts for mass production.*

4. *By extending our research facilities to aid the solution of any design or construction problem.*

1943

AS A RESULT OF THIS EXPERIENCE, Goodyear is today building bullet-puncture-sealing tanks that self-close punctures made by modern heavy-caliber ammunition which rips jagged, flaring holes in ordinary metal tanks. So swift is this sealing action, very little gas is lost and the danger of fire from incendiary bullets is greatly reduced. Goodyear supplies all types and sizes of these tanks to fit the varying needs of both fighter and bomber planes.

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The coveted Army-Navy "E" Award flag that now flies above the Wittek plant is a symbol of vital partnership between the war front and the production front. Our nation's highest industrial tribute is, to the men and women of Wittek, a challenge and a responsibility . . . an inspiration to even greater accomplishment in this one objective . . . VICTORY.

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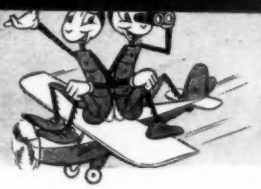
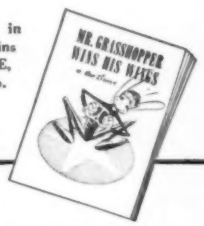
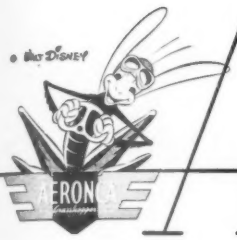


Abel Grasshopper and his flying mate speed up this all around training job.

That's the way to have 'em in any game of winner take all — and brother, war flying is just that! ☆ ☆ ☆ These lads aren't aces yet, but it'll take more than an Axis four-flush to top 'em . . . 'cause they're sitting pretty on this job for learning how, and learning fast . . . it's an Army Aeronca Grasshopper. ☆ ☆ ☆ Delicate on controls, she takes off, flies, and lands with big ship maneuverability . . . the greenhouse is made to an observer's prayer, and here's one light plane for pre-glider training, for C.A.P., and all-around work, which simulates basic conditions for instruction, and turns out smooth pupils fast. ☆ ☆ ☆ Designated as the Army's L-3-B, the best endorsement of their efficiency comes from the nine out of ten airmen who echo appreciation of these Grasshoppers as "First and Finest". ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

A full-color book to delight the young in heart . . . Walt Disney's "Mr. Grasshopper Wins His Wings". Send 10¢ in stamps to Dept. E, Aeronca Aircraft Corp., Middletown, Ohio.





AERONCA

FIRST *Grasshopper* FINEST

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You can now convert to SPEED NUTS to help meet your production schedules ON TIME. SPEED NUTS are approved by the U. S. Army Air Forces and the Bureau of Aeronautics for non-structural attachments on military aircraft. They are also used on jeeps, trucks, tanks, P. T. Boats and other war equipment. This provides a more abundant source of approved self-locking nuts to relieve the present shortage.

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That's why more and more firms in the industry are following the lead of other American firms, who for the past two years have been talking to official Washington through advertisements in The Washington Post.

Last year, for example, 172 national advertisers placed public relations copy in The Washington Post, for a total of 570,054 lines (equivalent to 234 pages)—many more advertisers, and much more space than in any other Washington newspaper.

American industry in general realizes—and Aviation is quickly learning—that being properly understood by the *men who make the laws*, and the *men who carry them out*, is an essential to firms with vision. And The Washington Post—outstanding newspaper in the nation's capital city—quoted more often in Congress than any other American publication—is the essential medium to use.

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Eve. & Sun. Star	**134**	**436,338**
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The Washington Post

EUGENE MEYER, EDITOR AND PUBLISHER

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MULTIPLICATION

★ In the month of December 1941, the United States was attacked by treachery. In anticipation of such a possibility, our Government had created a Defense Program. Under the Defense Program, by December 1941, the production of the Beech Aircraft Corporation had multiplied 12½ times over the production rate of the year 1939, when Hitler first unleashed his fury.

With war a reality, efforts were redoubled, and by December of 1942 the production rate of the Beech Aircraft Corporation had reached the astonishing level of more than *100 times* the average production rate for the year 1939.

This story, repeated all over the United States, for all sorts of weapons of war, is the prophecy of disaster for the Axis aggressors.

Comparative Rate of Beech Airplane Production

Year 1939	100%
December 1941	**1,250%**
December 1942	**10,000%**

A Beechcraft AT-11 Drops a Stick of Bombs

Beech Aircraft

CORPORATION

BEECHCRAFTS ARE DOING THEIR PART *WICHITA, KANSAS, U. S. A.*

THE STORY OF WILLOW RUN

'WILL IT RUN?'

by ROBERT STEWART

Photographs from Ford Motor Company

This is the north side of Willow Run's final assembly department.

An enigma from the start, Henry Ford's gargantua has puzzled layman and expert alike.

WILLOW RUN, the glamor girl of the automotive industry's warplane production program, has put her hair up in a snood and gone to work. She is extremely serious about doing her part to help win the war, and henceforth her accomplishments will be written up in the German newspaper obituary columns rather than in the Detroit society pages.

Willow was handicapped from birth. Her grandfather once declared that he could build 1,000 planes a day, so a lot of silly people think Willow ought to be able to. She can't and she won't. She will be upholding the Ford reputation if she knocks one out every hour when she hits her stride. That's a lot of bombers, even for a 20-hour day.

And because she was born a Ford, a daughter of the social leaders of the automotive industry, some folks got the idea that Willow was a kind of Superman who could perform miracles in any field of endeavor. True, she is a big girl, but bigness produces its own problems—which Willow has not entirely mastered.

A lot of friends and relatives attended the birth of Willow Run, and there was some disagreement among them as to exactly what career she should follow. Her Uncle Sam, from Washington, who had written out a whopping big check to her name, wanted Willow to be a modest girl and confine her production activities to subassemblies. Her Grandfather Henry, who has a mind of his own (and a big checkbook), insisted on Willow going all the way as a career girl—producing completed bombers and, as a concession to Uncle Sam, subassemblies for assembly elsewhere as well.

Willow's parents insist that she is equipped to do only one thing, and do that extremely well—build Consolidated *Liberator* B-24 bombers.

Today Willow Run is building *Liberators*. She has been delivering them to her Uncle Sam since early last fall. A handful now and then, at the start; now on a carefully laid-out schedule, which calls for constant acceleration. March production was scheduled to run into three figures.

Peak effort, which may see that goal of one bomber an hour realized, is slated for early this fall—providing Uncle Sam, who is taking all the bombers, does not ask for too many changes in them.

All fantasy aside, what about Willow Run? Or, as some skeptics insist, "Will It Run?"

The curse of the Ford bomber plant from the very beginning has been loose talk and public willingness to accept as

Beginning to take shape, the bomber now has about half-finished wings and engines are already installed.

A photographic panorama shows "Liberators" coming down twin assembly lines.

gospel truth everything that appears in print. Like many another airplane factory which now is producing warplanes, Willow Run was once a lowly cornfield-and-woodlot. That was in March, 1941. Today, exactly two years later, it is producing (censored) bombers a day. That is not a bad record, considering the vastness of the enterprise—it is the largest integrated manufacturing establishment under one roof—and the complexity of the product.

But the curse of Willow Run stepped in last May—14 months after woodsmen started clearing ground for the plant—and planted a story in a Detroit paper to the effect that Willow Run was then "in production" on B-24 bombers and that the rate of delivery of completed bombers was a "military secret." This story was carried throughout the world on the wires of the major press associations.

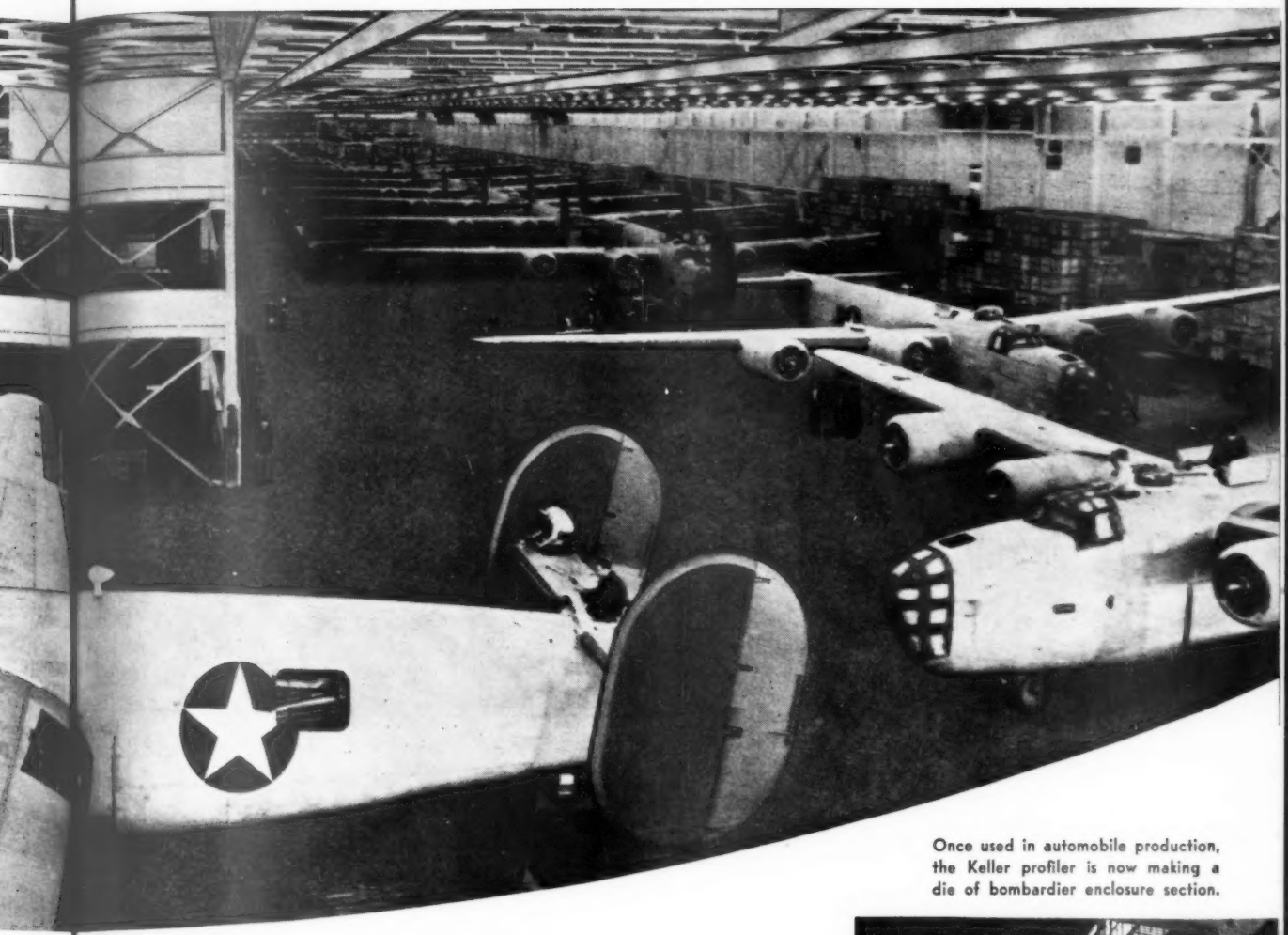
At about the same time Sir Oliver Lyttleton, British production chief, told the peoples of Occupied Europe in a beamed broadcast, that Ford *then* was producing a "bomber an hour" earmarked for the destruction of Hitler and his hordes.

This was beautiful and no doubt effective propaganda for the Continent and even the "tight little isle." But the cables brought this authoritative report back to the United States, the wire services distributed it to their clients—and the newspapers of Detroit printed Sir Oliver's remarks on the front page.

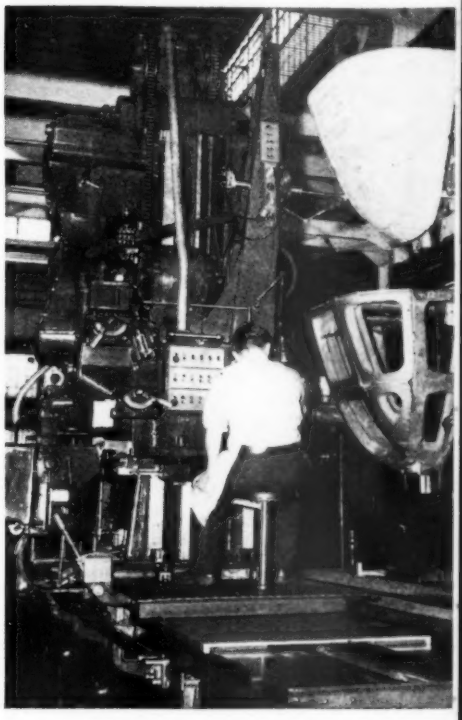
No wonder, then, that the opinion prevails that Willow Run is far behind schedule.

The original Detroit story of a year ago was factually correct, depending upon the interpretation of "production" and the connotation placed upon the word. But it was deliberately misleading. As a matter of fact, Willow Run was "in production" in November of 1941, even while construction workers still were erecting the huge assembly bays, because bits and pieces were being produced on a scattering of machines in the then-completed machine shop.

Another factor contributing to the general confusion about Willow Run was the announcement by the company on May 15, 1942, that it had turned over to flight test the first bomber assembled at the new plant. This was strictly an educa-



Planes in foreground roll toward the paint and pre-flight departments.



Once used in automobile production, the Keller profiler is now making a die of bombardier enclosure section.

tional project, and the airplane was assembled mainly from parts and subassemblies shipped in from the Consolidated plant at San Diego.

But if the start of actual bomber production at Willow Run failed to meet the forecasts of top Ford executives and the expectations of veterans of the aircraft manufacturing industry (leaving public misconceptions out of it entirely), then consider these factors:

1. Because Willow Run, of all the aircraft plants in the country, most nearly approximates the automotive industry's conception of quantity production, it is more elaborately tooled than any of its contemporaries. Its steel dies (as opposed to Kirksite); its heavy steels and concrete jigs; its high degree of departmentalization, of breakdown into the smallest possible subassembly unit; its multiplicity of jigs and fixtures (30 identical center section wing fixtures, similar duplication throughout), all represent a tremendous investment in make-ready time.

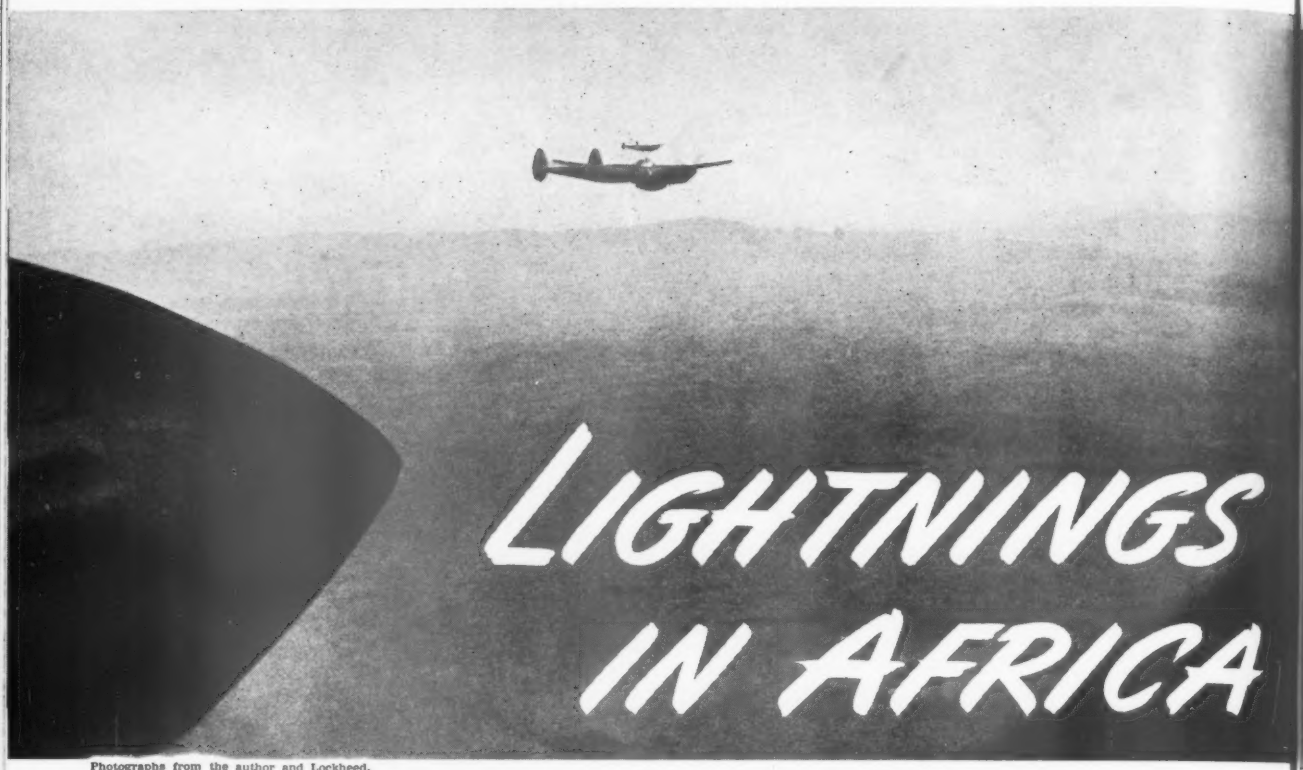
2. Because Willow Run, despite its size and the magnitude of its undertaking, still is regarded as a subcontractor to Consolidated, it is necessary to obtain Consolidated's approval of hundreds of minor design changes which are made necessary by Ford's innovations in production technique. These cannot always be immediately approved, and even the changes take time.

3. Unlike its contemporary, the Boeing *Flying Fortress*—which itself has undergone six major model changes and thousands of design and engineering changes—the *Liberator* also has been found adaptable to transport and cargo use, with the result that Ford has had to put through innumerable design changes for this model of the B-24 for which he is supplying Consolidated's Fort Worth and Douglas' Tulsa plant with subassemblies.

4. Willow Run has had the very devil of a time attracting and holding enough workers to man its machines and staff its assembly lines. More trouble, without doubt, than any other manufacturer. Manpower continues to be the No. 1 deterrent to all-out production there, according to Charles E. Sorensen, Ford vice president in charge of production.

Points 1 and 4 are the major ones, and

(*Continued on page* 150)



LIGHTNINGS IN AFRICA

Photographs from the author and Lockheed.

"Lightnings" of the author's squadron, taken by one of the pilots during a patrol flight.

by Capt. WILLIAM J. HOELLE

As told to ROGER WILLIAMS

Almost every criticism of the Lockheed "Lightning" has been proven false by the pilots who are fighting in Africa's skies.

Capt. William J. Hoelle

THE bewhiskered Italian army officer, his uniform tattered and torn, gazed sullenly at American intelligence officers firing questions at him at an advanced air base in North Africa. Suddenly, in response to a particularly pointed question, the Italian officer snapped to attention, threw back his head defiantly, and exclaimed:

"We were doing all right and winning the war until those damned forked-tail airplanes showed up!"

Our Italian captive made reference to the famed American P-38s, or Lockheed *Lightnings*, a twin-engined intercepter with 1,350 h.p. Allison engines. No higher compliment has been paid the P-38's and the boys who fly them.

Maj. Gen. Jimmy Doolittle, who led the spectacular bombing raid on Tokyo and who now is commanding our air forces in Africa, has said some mighty fine things about the P-38, but I doubt that anyone could have stated the point more forcibly than the disheveled and unhappy Italian officer.

No plane has taken more criticism than the Lockheed P-38, and to my mind no plane has more thoroughly demonstrated how unfair and uncalled for that criticism has been. The *Lightning* has proved of inestimable value in the fighting in North Africa, as well as on other fronts.

I have just returned from North Africa, where the Blank Fighter Squadrons, comprising the Blank Fighter Group, under command of Col. Thayer S. Olds, proved without shadow of a doubt that the P-38 is one of our most effective all-around fighter planes.

For three months it was my good fortune to participate in 47 missions over enemy lines with the Blank Fighter Squadron, which I now command. I've seen what the P-38 can do under any and all circumstances. I can honestly say the ship has come through with flying colors.

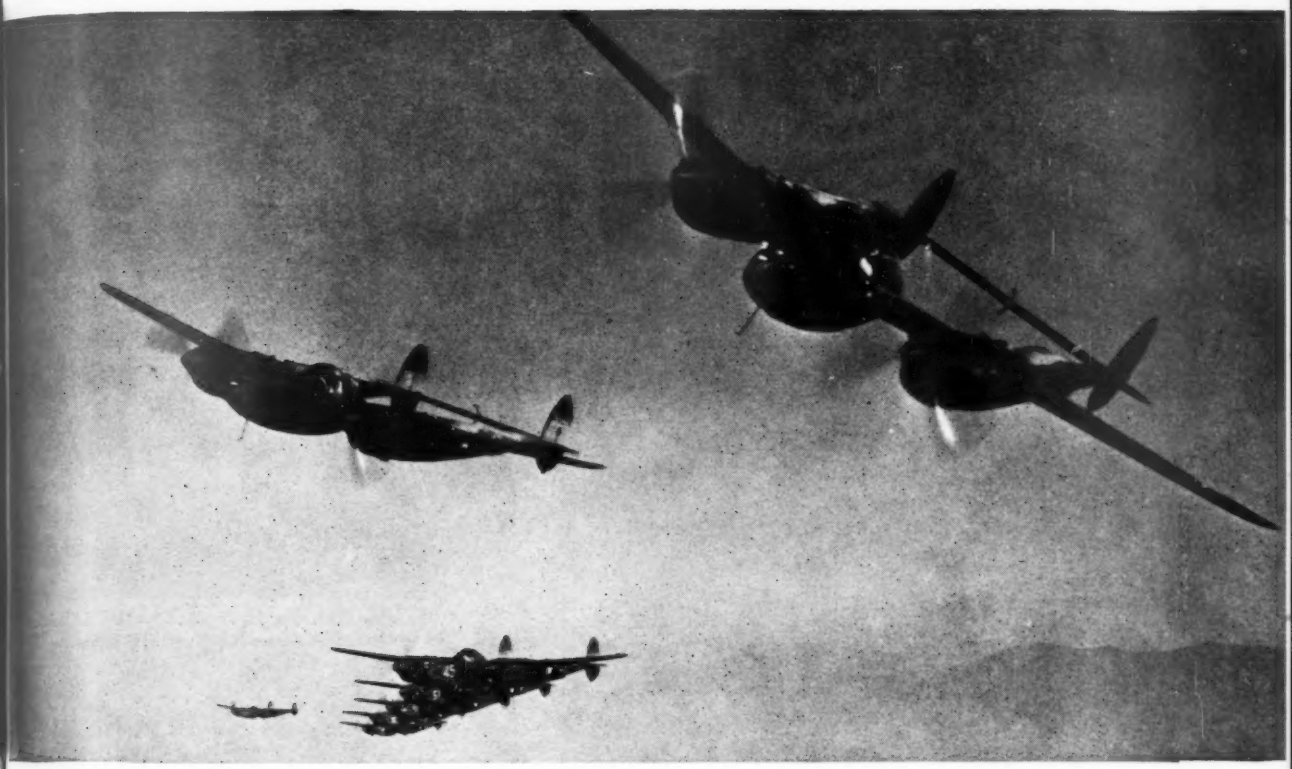
Criticism directed against the plane has been varied. For example, it was belittled as lacking sufficient firepower. I am not at liberty to disclose what the firepower is, but I can say it is ample.

When we first arrived in North Africa, we thought the P-38 would not work out well as a ground support airplane, but after seeing the results of concentrated firepower against trucks, columns and tanks, we knew we really had something.

The ease and accuracy with which firepower can be controlled in a P-38 is important. The fighter pilot is able to put a bead right on the target and the firepower, which centers in the nose, does not converge toward a point but remains intact throughout the pattern.

Another criticism of the P-38 has been directed against its alleged inability to perform on a single engine. Nothing could be farther from the truth. Such tales of single-engine operation cause apprehension among new pilots. When the engine quits on either side, the tendency is for the good engine to pull the plane over and into a spin. But this tendency can readily be offset.

In the Blank Squadron and its sister squadron, the Blank, commanded by Maj. Wade C. Walles of Beaumont, Tex.,



"Lightning" P-38's have come into their own in Africa where they have been used as ground strafers, light bombers, tank destroyers and as convoys for big bombers. The planes have proven that they are able to fly and fight with one engine dead.

there were numerous experiences where one engine was shot up, yet the pilot always managed to return to his base. This proved to us that one engine operation can be performed successfully even under combat conditions. [We have heard of numerous incidents, particularly in the Aleutians where the *Lightning* first proved itself, in which the failure of one engine was successfully coped with. In nearly every case, the pilots have stated flatly that they never would have been able to return to their bases had it not been for the fact that they had the second engine with which to fly home.—Ed.]

The procedure followed when one engine quits is to cut back both throttles and then gradually feed the good throttle forward, using opposite rudder to offset the thrust of the engine still functioning. Ability to relax and think clearly, which comes automatically after experience, will allow the pilot to cope with any emergencies that arise when one engine quits. In the event both engines cut out at the same time, it might be wise for the pilot to turn the selector switch on the tank containing the reserve gas supply.

This latter may seem like needless advice, but we actually had a couple of instances where pilots ran out of gas and crash-landed only to discover to their chagrin that their reserve tanks still carried plenty of gas. They simply had forgotten all about them.

I can readily cite a number of examples where P-38's came through combat on one motor, and did a good job of fighting the enemy at the same time. On one occasion, Lieuts. Robert Carlton of San Jose, Calif.; Virgil Lusk of Santa Rosa, N. M., and James Butler of Georgia were out strafing the airport at Gabes. Lieutenant Carlton's plane was hit by flak and the right engine disabled. The flight decided to head for home.

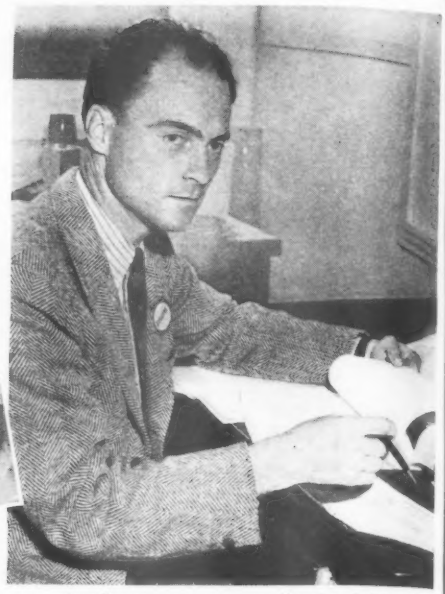
On the return trip, some 30 miles north of Gabes, the three ships ran across nine Italian troop transports. The trio of P-38's, with Lieutenant Carlton flying his ship on one engine, proceeded to shoot down the entire nine enemy ships, all heavily loaded with troops. Lieutenant Carlton got one, Lieutenant Lusk five and Lieutenant Butler three.

In flying over to inspect the blazing ships on the ground, Lieutenant Lusk's

(*Continued on page* 136)

Seated on a slit trench on the outskirts of an African P-38 station, the author (foreground) and two other "Lightning" pilots take time out to write home.

Russell Raymond Rogers now heads Consolidated's flight department.



Art Bussy, once a test pilot for Bellanca, Beech and Edo, now test-hops "Liberators."

Rodney Jackson is a test captain.

THOSE YOUNG

They are old men as they consider pilots of fighting and bombing planes today, but these tough test pilots need the experience of age.

Photographs from Consolidated

YOU can't keep the "young old men" out of the air.

Today, the men who in their twenties made names for themselves in a dozen different fields of aviation find themselves doing even more important work.

They're in their thirties and their forties now.

But they're old in experience.

They test the fighting craft which those "kids" in their twenties will fly for the United Nations. They help engineers get the "bugs" out of prototypes, they run routine production shakedown tests. They disperse airplanes to all parts of the United States.

And, more than this, they do extensive ocean flying.

They used to feel pretty smart when, during their twenties, they got commercial licenses. Today, they look back with a wry grin at their cockiness.

They're sane, cool business men today. They hold ratings for land and sea to 8,800 h.p. They hold instrument ratings. They have learned dead reckoning and celestial navigation. They are practical engineers.

You'll find a lot of them at Consolidated Aircraft Corporation, at San Diego. They do all sorts of flying in the big fellows, the four-motored Consolidated *Liberators*, the four-motored flying boat, the *Coronado*, and the sturdy two-motored *Catalina*.

Consolidated's flight and service department, largest in the manufacturing field, employs more than five score pilots, of which half are in the "young old" classification. The entire department consists of nearly 1,000 employees.

Figures having to do with the experience of the pilots are amazing. A survey reveals that these pilots have been flying for 1,276 years when you total their collective experience. They have been in the air for 339,032 hours. It is estimated that they have flown 50,854,800 miles.

One of the "young old men" heads the department.

Richard McMakin, executive assistant to Rogers, forsakes his desk when new models need testing.

Douglas "Doug" Kelly became a flyer in 1925 as a graduate of Kelly Field. He has amassed over 5,000 air hours as a pilot.

OLD MEN...

by
EDWARD CHURCHILL

Flight Supervisor Richard Mitchell discusses a test hop with Doug Kelly and Jim Barwick.

He has devoted himself to finding pilots who have become skilled as the result of thousands and thousands of hours in the air; who have a sane, businesslike regard for their work; who have thought enough of their own careers to get experience in every type of plane, to master instrument flying and to learn navigation.

He believes in teamwork.

You've probably heard of him.

He's a stocky, amiable fellow named Russell Raymond Rogers.

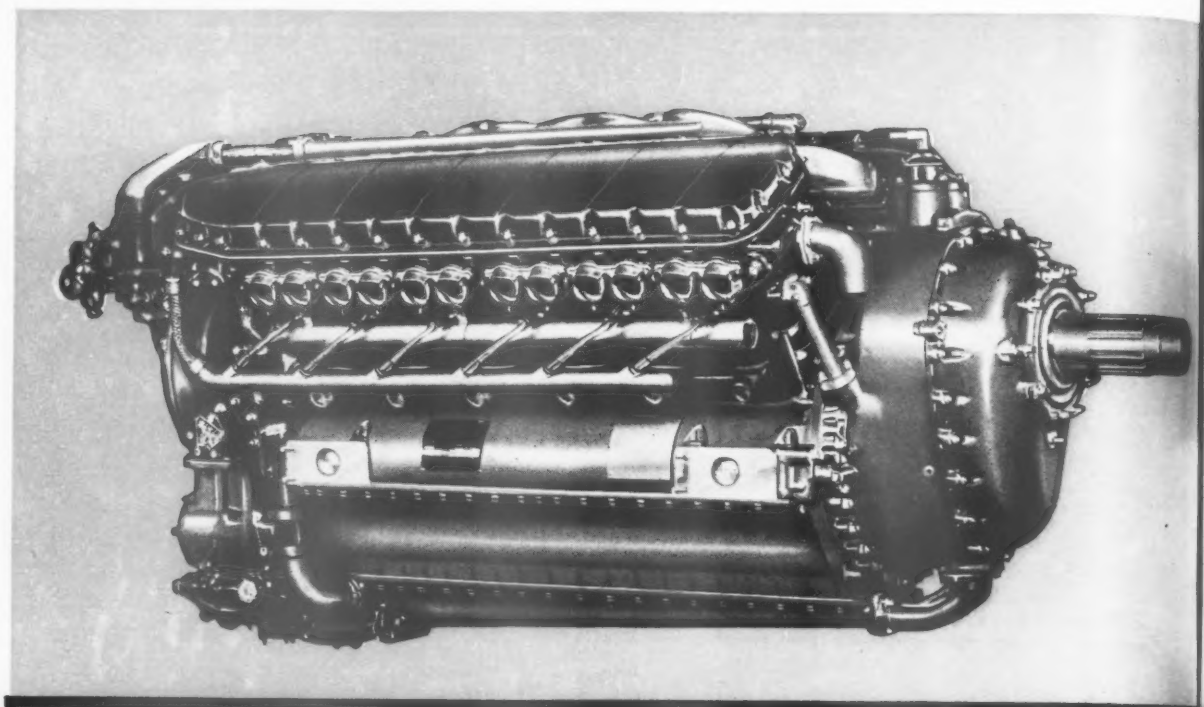
"You have to have teamwork when you fly the big fellows," Russ says. "You have to have cool hands."

Russ is 36 years old.

He was born in Poughkeepsie, N. Y., June 19, 1906. He soloed at the ripe old age of 15, which means that he has been testing, exploring and doing various other types of flying for 21 years.

He and his men have been doing a big job. They've been running prototype tests, have been getting airplanes off the production lines with little to-do about

(*Continued on page* 156)



the ALLISON

by
WILLIAM
LEVENOR

THE question of the relative merits of liquid-cooled and air-cooled aircraft engines has been for years an excuse for the bandying of words in the public print.

Inquire closely, and it becomes evident that the most eminent aeronautical engineers are as yet unable to reach any substantial agreement on the subject—a fact that fails entirely to check the dogmatic assertions of the enthusiasts on both sides.

The feud has meant in this country frequent criticism of the Allison engine, the 12-cylinder Vee-type high-horsepower plant that powers most of the Army's standard fighters. This criticism, moreover, is by no means confined to the air-cooled versus liquid-cooled controversy, but extends to the Allison versus other liquid-cooled engines — Rolls-Royce, Daimler Benz, Junkers *Jumo*, Hispano-Suiza—with the all-too-frequent result that the writer concludes that, of all the world's liquid-cooled aircraft engines, the Allison is incomparably the worst.

One "military analyst" went so far as to assert that the "inferiority" of American fighter planes was due to the fact that the Allison could not be supercharged! That opinion could have been based only on (a) some startling oversights, plus (b) a rather silly assumption.

For (a) two examples will suffice—the Lockheed *Lightning* had been designed around two turbosupercharged Allisons several years before the "military analyst" decided it couldn't be done; the shift from Allison to Rolls-Royce in the *Warhawk*, latest of the Curtiss P-40's, produced no extraordinary changes in altitude characteristics of the plane. This brings us to (b)—the assumption, not only silly but quite prevalent, that unless a fighter is a high-altitude plane, it is "inferior."

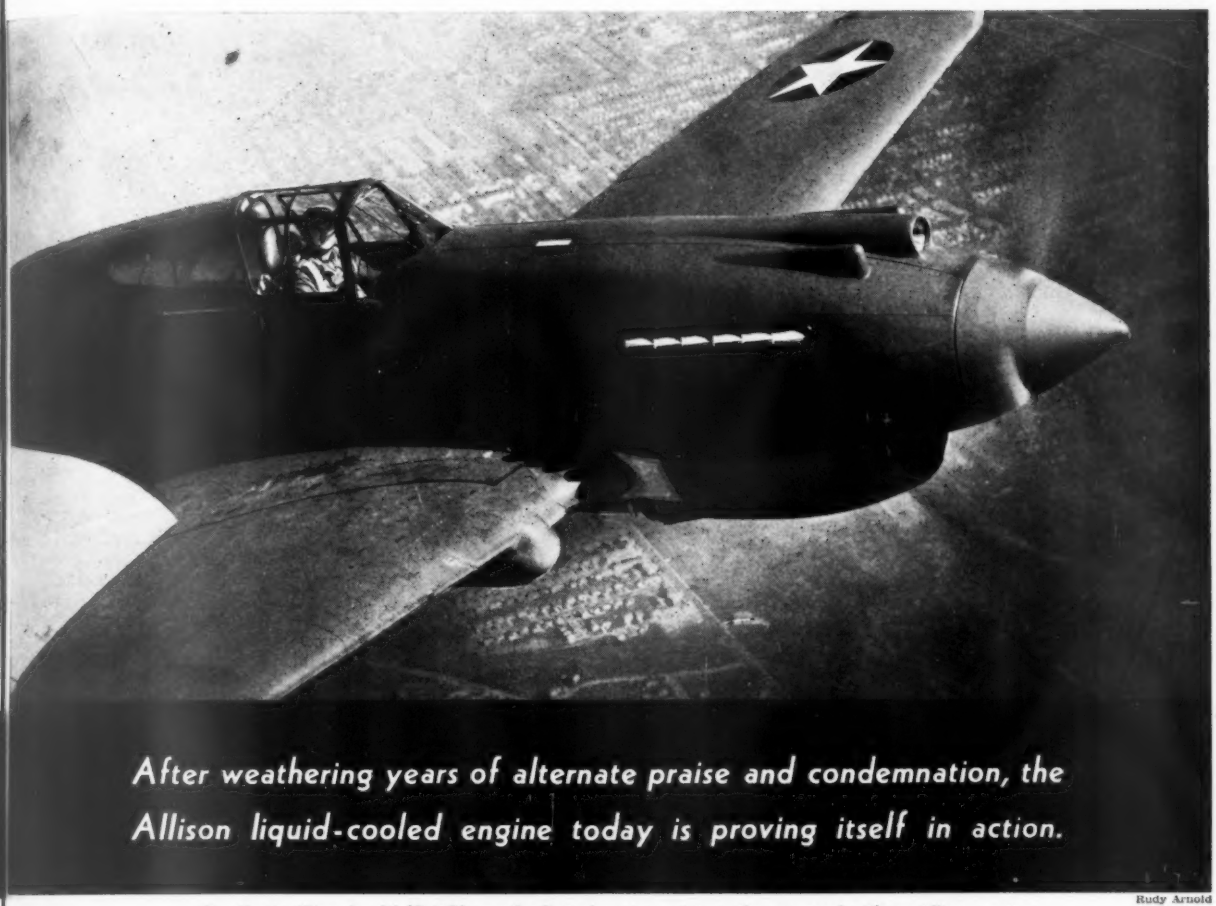
On the other hand, the liquid-cooled point of view has been set forth with equal enthusiasm and equal disregard for accuracy and restraint.

The development of commercial aviation in the United States, a development greater than in any other nation, has as everyone knows been accompanied by the almost universal use of the radial air-cooled engine.

A number of generally accepted facts account in large part for this trend. The radial air-cooled engine has been considered simpler in construction. In practice, the air-cooled was supposed to operate about twice as long between major overhauls as did the in-line liquid-cooled engine. Its output of power per pound of weight had been greater in the past—on the average the air-cooled weighed about 1.6 pounds, the liquid-cooled about two pounds, per horsepower. [The Allison today is down to 1 pound per horsepower.—Ed.] All these are factors making for economy of operation, which obviously is a matter of prime importance in commercial aircraft.

On the other hand, the liquid-cooled possesses its own inherent advantages over the air-cooled; advantages given close attention in the design of military planes in which speed and power for combat come ahead of economical operation. Among the advantages generally claimed for the liquid-cooled are these:

(1) The engine can be operated at a higher power output per cubic inch of piston displacement due to the type and uniformity of cooling; (2) because of the heat capacity of the liquid coolant, the engine is less sensitive to temporary overloads, and therefore more reliable in the stresses of combat; (3) the frontal area is smaller, with consequent reduction in drag; (4) there is greater flexibility of



After weathering years of alternate praise and condemnation, the Allison liquid-cooled engine today is proving itself in action.

Rudy Arnold

The Curtiss "Tomahawk" (P-40B) was the first plane to go into action powered with an Allison engine.

engine location. The latter point is based on the fact that the cooling element is independent of the engine, so far as dimensions and location are concerned, which frees the designer of many restrictions imposed by air-cooled engines.

It should be pointed out here that the argument about frontal area and its drag (a point giving rise to the liquid-cooled enthusiasts' charge that radials are "built-in headwinds") is by no means ended.

It's axiomatic that the horsepower required to overcome wind resistance increases as the cube of the speed; double the speed of a plane, and the power must be increased eight times. Now the frontal area of a 1,200 h.p. air-cooled engine is about 1,800 square inches, that of a 1,200 h.p. liquid-cooled engine about 900 square inches—a comparison that explains the opinion of many engineers that at speeds over 400 m.p.h., even with optimum cowling for the radial, the smaller frontal area may give the liquid-cooled an advantage of 20 m.p.h.

On the other hand, equally competent and learned engineers point out that as the power goes up, so does the size of the propeller and of the spinner. This, they say, soon obviates the streamlining advantage of the in-line engine, since the radial can be hidden behind the large spinner. Some go on to the assertion that the radial's drag actually can become less than that of the in-line engine, because there is no exposed radiator.

Is this opinion based on an assumption that the size of the radial engine does not increase with the rise in power output? That would seem to be hardly a safe assumption in the light of experience to date. And while no successful in-line aircraft engine of 2,000 h.p. or better has yet proved itself, Allison some time ago upped the rating of its standard engine by about 300 h.p., and at the same time reduced the frontal area by 10 per cent as well as achieving cuts in other dimensions and in weight.

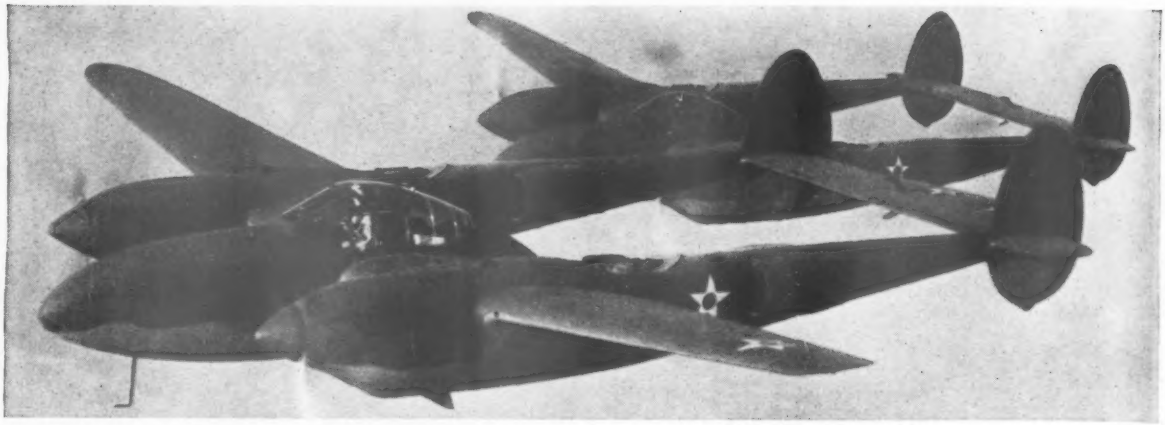
Settlement of the controversy will come, if ever, out of wind-tunnel experiments and flying tests. And for the present, the in-line liquid-cooled engine powers most of the world's top-notch fighter planes. The Allison is not the only American engine of this type, but it is the only one now in general use. What is its background?

Back in 1915, James A. Allison, one of the founders of the Indianapolis Speedway, opened the Allison Speedway Team Company, a 20-man shop, to build and service racing cars for his three teams.

Two years later the shop's precision facilities were placed at Government disposal, and Allison entered the aircraft industry for the first time, building tools, jigs, fixtures and experimental models for the production of *Liberty* engines. Orders for production models of superchargers, whippet tanks, trucks and high speed tractors expanded the shop to 100 mechanics and 150 designers and engineers, and it emerged from the war as the Allison Experimental Company.

After an Allison car won the 500 mile international sweepstakes in 1919, the Allison Company abandoned motor car racing to devote full time to experimental work, keeping its organization together despite the disappearance of Government orders after the war ended.

In 1927, the Army and Navy asked Allison to rebuild 2,000 of the 10,000 *Liberty* engines produced during World War I. One assignment was to rebuild a *Liberty* to use 20 per cent benzol, 80 per cent aviation fuel, in an attempt to increase horsepower from 400 to 570. The attempt was not a success—connecting rods in the rebuilt engine broke down; but the project aroused the interest of Allison and his shop superintendent, Norman H. Gilman, in the development of a high-power liquid-cooled engine at a time when the attention of American aviation engineers



Lockheed "Lightnings" (P-38's) are powered with a pair of Allisons developing 2,300 h.p.

was being devoted largely to radials, which had powered the sensational trans-oceanic flights of the 1920's and established themselves as the engines for commercial transports. Allison was almost the only American liquid-cooled laboratory to pace the European liquid-cooled aviation development.

Allison died in 1928, and his precision engineering company was acquired by General Motors the following year. Gilman remained head of the organization and obtained General Motors financial and research backing for his pet project —the development of a 1,000 h.p. liquid-cooled engine.

Before undertaking this work, Gilman tackled a preliminary job—finding a substitute for the bronze-backed babbitt bearings which had left much to be desired in the *Liberty* engine. Allison engineers perfected steel-back, leaded bronze bearings that could withstand the greater loads required for more power output, and these "copper lead" bearings later became standard in most high-powered aircraft engines.

This accomplished, the problem of the engine itself was approached. The earliest efforts were devoted strictly to laboratory research, and the General Motors Research Laboratories in Detroit, headed by C. F. Kettering, contributed considerable assistance. By 1933, the Army Air Corps had become interested in the development.

Glycol ethylene (base chemical of Prestone) with its boiling point of 357°, presented possibilities as a coolant that would permit running an engine at 250° to give higher power output than a 160° water-cooled engine and control advantages over the 400° air-cooled engine. An unsuccessful attempt to substitute glycol for water in a Curtiss V-12 *Conqueror* engine demonstrated the leakage problem involved in the use of the oily, fast-running chemical as a coolant.

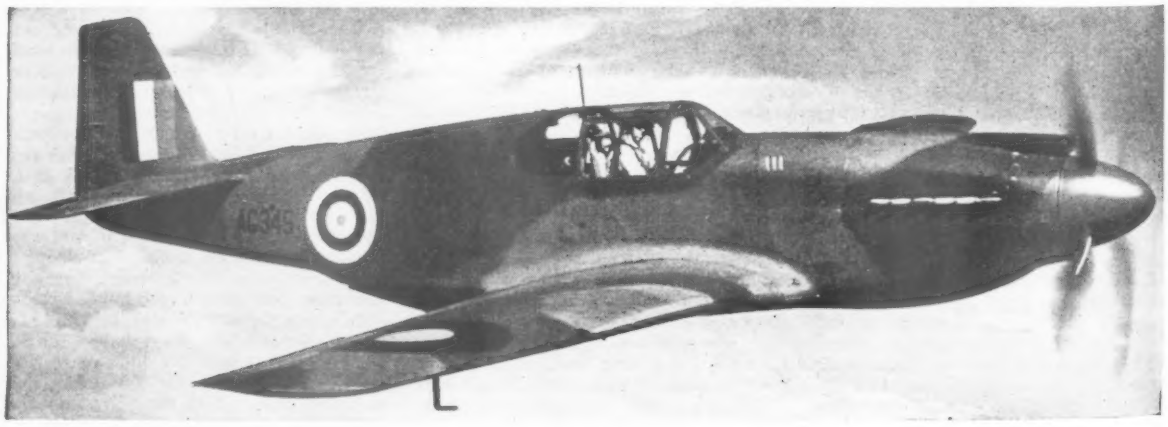
The answer to this problem was an Allison-designed coolant unit that could be tested for pressure and temperature prior to assembly. This unit, which pumped glycol six times as fast as water, could cool an engine effectively with one-third the radiator size of a water coolant unit. Its development forecast a lighter engine and the possibility of realizing the goal of one pound of engine weight per horsepower.

The new coolant unit was a feature in the first Allison V-1710-A, built in 1931, for the U.S. Navy. It was found necessary to modify several parts after half of a 50-hour development test. The following year, the modified engine rated 750 h.p. at 2,400 r.p.m. in a successful development test. Redesigned engines to serve as reversible unsupercharged engines were ordered to replace German liquid-cooled engines in the dirigibles *Akron* and *Macon*. The shifting of camshafts, magneto and distributor fingers enabled this "B" engine to reverse from full power in one direction to full power in the opposite direction in eight seconds. Model tests were completed in 1935, and the Navy ordered 22 engines, but only two were shipped before the dirigibles were tragically lost and the Navy abandoned lighter-than-air development.

Meanwhile, the Army had ordered a redesign of the first V-1710, and this model, known as the V-1710-C, weighed 1,122 pounds, 100 more than the original "A." A satisfactory 50-hour development test was completed at a rating of 800 h.p. at 2,400 r.p.m. In 1935, an improved model, on a second development test, was rated at 1,000 h.p. at 2,650 r.p.m.

The attainment of 1,000 h.p. was hitting close to the Allison goal. A few items required redesign, but general performance warranted the undertaking of the 150-hour type approval test necessary for final Army acceptance of the Allison V-1710 as an approved power plant for

The North American "Mustang" has been designed for either the Rolls-Royce or Allison power plant.



new-design military planes.

At the Allison plant, the engine was run at increasingly higher horsepower outputs in preparation for the test—and things went "haywire." Vibrations twisted off the crankshaft, crankcases cracked, valves burned out, bearings failed.

Gilman decided on a major redesign of the engine. Ronald M. Hazen, who had been working on Allison engineering problems for four years at the General Motors Research Laboratories in Detroit, was given the difficult assignment. Hazen had designed the Ranger aircraft engine before coming to Allison, and was Gilman's choice as chief engineer.

In exactly three months and three days, every part of the engine except the connecting rod was redesigned under Hazen's direction, and the model was built and delivered to the Army June 13, 1936. Shortly afterward the grueling 150-hour test began at Wright Field.

With each succeeding report from the Field, confidence rose at the Allison laboratory. When the news came that the engine had run sweet and true for 140½ hours, Gilman was sure that 9½ more hours would see the realization of his dream. He decided that the time had come to retire, and he dictated his resignation against the following day when the triumph of the Allison engine would be final. But he had to tear up his resignation the next morning.

There was still work to be done. The engine, started again, developed a disqualifying crack in the head of one bank of cylinders. With a new block of the same design installed, the engine operated on a penalty run for 245 hours when the cylinder head in the other bank failed in a similar fashion.

This was conclusive proof of a defect in one particular, but the design as a whole was pronounced fundamentally sound. The Air Corps, enthusiastic, cheered up the heartbroken engineers by ordering several engines built for experimental airplane installation.

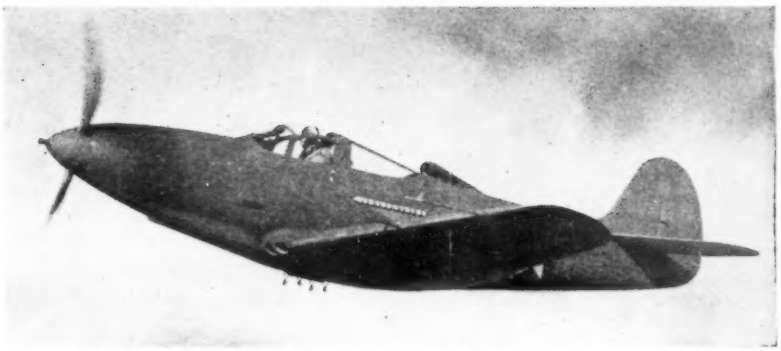
Meanwhile, Allison engineers started to iron out the last defect in their design. They found that the cylinder head cracked for want of several ounces of aluminum—all that was necessary to strengthen the head between No. 3 and No. 4 cylinders and reduce deflection one-fifth. However, the interrelation of all parts of an aviation engine is close, and the new stiffened cylinder head led to vibrations of hold down studs in the manifold that made a redesign of this part necessary.

The Allison V-1710 C-8, with redesigned cylinder blocks and manifolds, passed the 150-hour type approval test with flying colors March 23, 1937, and became the first aviation engine to establish itself at a normal rating of 1,000 h.p. on a military test.

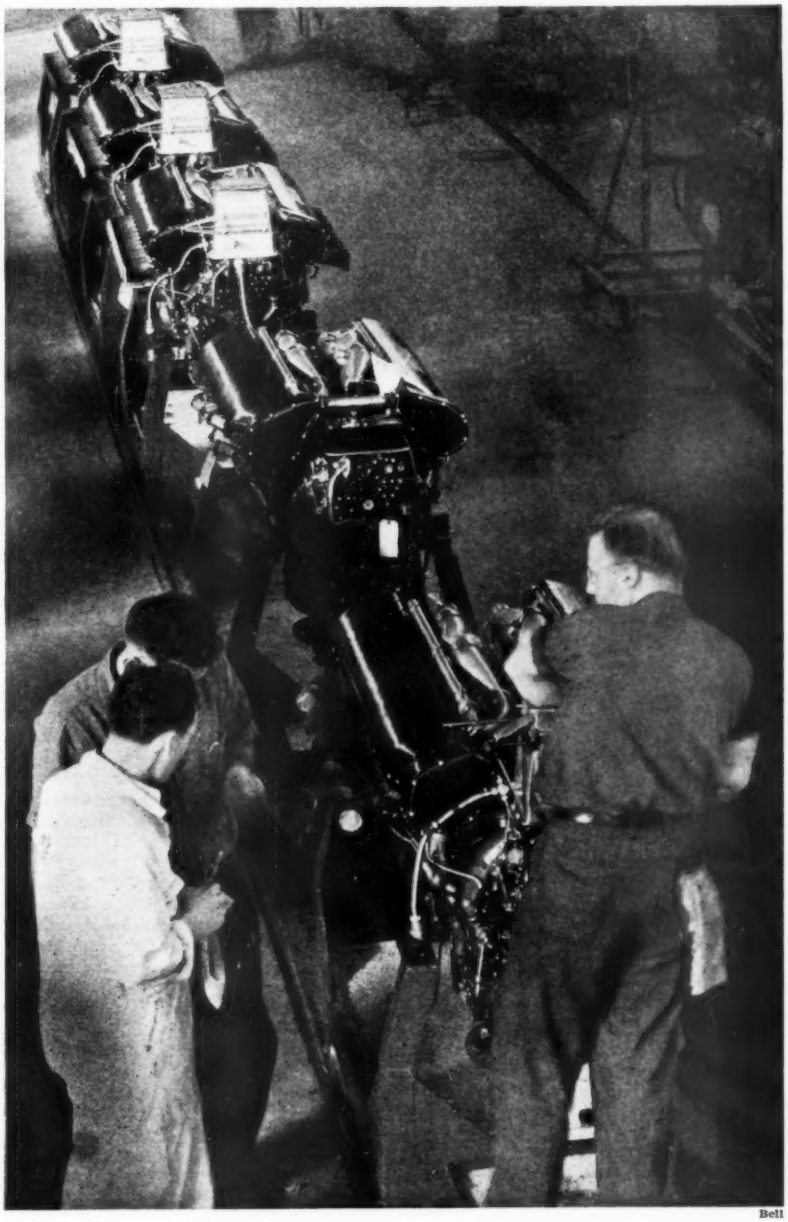
The engine, however, could not be put into production immediately. Two years were taken for the intermediate steps of flight-testing, detail improvement of the engine, and design of aircraft before a model of the Allison could be frozen into production.

In 1937 and 1938, with war in the air,

(*Continued on page* 84)



American engineers were the first to solve the problem of connecting a long drive shaft between the engine and the propeller unit when they developed a 10-foot-long drive for the Bell "Airacobra" (above). Lower photograph shows Allison engines prior to being attached to shaft and installed in the P-39.



Bell

Overhaul of instruments is a vital part of airline maintenance. It requires highly-skilled workers.

YOUR FUTURE IN AVIATION ★ ★ ★ ★

by MARVIN MARTIN

IF YOU cannot have the pleasure of bombing Tokyo; if you are too young to join the Air Forces in defeating the Axis powers, is there any use of hoping to get into aviation? After the war, there will be so many trained and experienced men, the younger fellows will not have a chance—or will they?

Your future in aviation will be there, perhaps with bigger opportunities than you can now conceive. The world today is seeing with startled eyes the effect of aviation on the world conflict and on our everyday lives, but tomorrow's world will be just as revolutionized by aviation as were the post-war 20's by the automobile.

Most people concede that military aviation will be maintained at a peacetime level exceeding anything heretofore known, so that many of those trained in the service will stay with it. They may not afford as much competition in commercial fields as might be feared. Commercial aviation is bound to experience a tremendous boom because the war has awakened the public to aviation: they cannot evade it, and when peace comes they will be more than receptive to it.

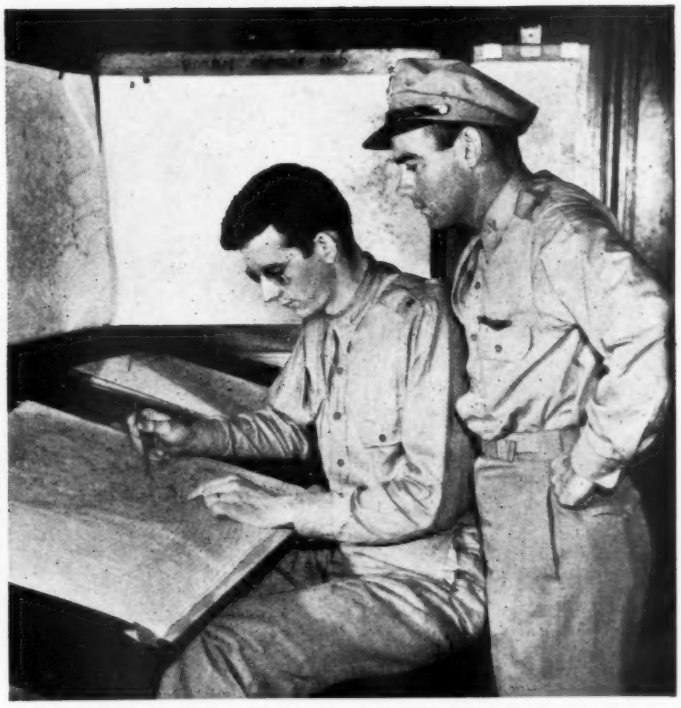
Aircraft manufacturers are making plans for marketing small private planes, commercial airliners and cargo planes which will open up more jobs. Possibilities are great for carrying all first class mail by air. Traffic in air express and air freight is still an almost untouched field. The industry will expand rapidly, requiring not just numbers of factory workers, mechanics, and pilots, but business and promotional men who understand aviation.

There will be a place for you—if you are prepared. I have talked with and instructed many students, I was once an aviation student myself and I have worked on an airline for several years. Out of my experience I can point out a few facts that may set you on the way to being a success in aviation.

If you are still in high school or college now is the time to begin your preparation. The subjects you dislike the most in school may be the very ones that you will need the most in later years. If you can visualize your needs now you may overcome your dislike or at least be able to give your attention to these fundamental tools of your training. Mathematics through trigonometry, and physics, are especially helpful in many jobs in aviation. Other subjects most frequently needed or of use are chemistry, mechanical drawing, machine shop, typing, public speaking, English, commercial law, bookkeeping, economics, and of course any aeronautical subjects that may be available.

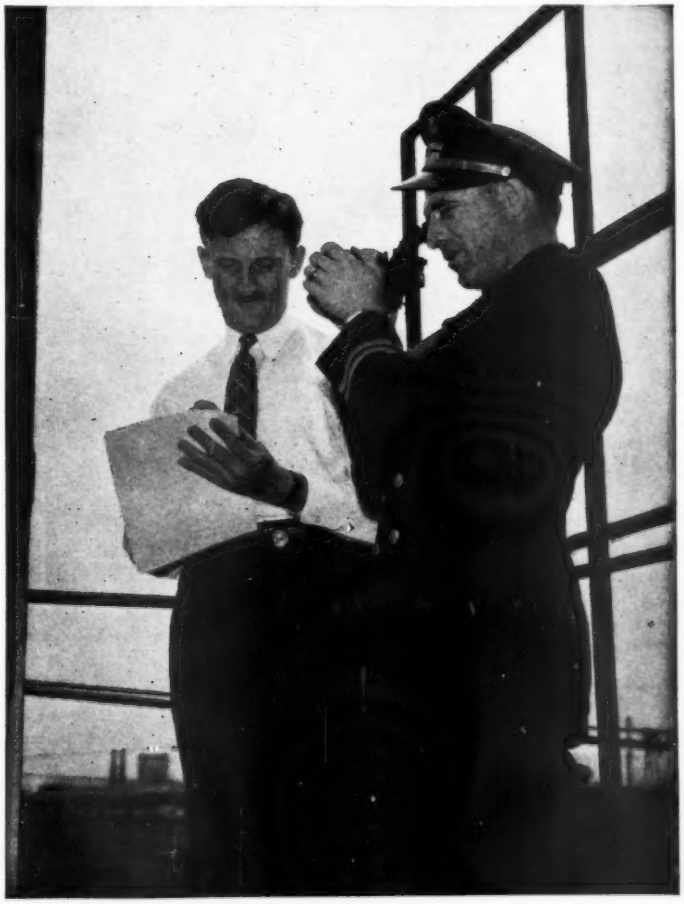
Frequently aviation students do not understand why they have to take certain subjects that have nothing to do with what they are studying. For example a mechanic student may wonder why he is required to include typing in his course,

Many will find their niche in airline operations.



Hundreds of meteorologists will go to post-war lines from Army and Navy.

Importance of celestial navigation grows with globular airline expansion.



The "Help Wanted" sign will be conspicuous in the aviation industry if present expectations are realized in post-war days.

or a traffic student will want to know why he has to study the principles of meteorology, or the meteorology student may object to taking some navigation. Experience shows that he may have to use them in some way, especially if he is stationed at a small intermediate stop on an airline and has to help on almost anything that might take place. Or in applying for a job there may not be a vacancy in the type of work he wants, but if he can handle some other job where there is a vacancy it will enable him to take it and get started with the company. In that way he will be right on hand when there is an opening in the work he prefers.

By acquiring a good foundation in high-school and college, and supplementing it with specialized training at one of the best Government-approved aviation schools, you will be prepared to take your place in the industry. Short cuts do not exist, and the random preparation of ro-

Many women are employed in airline teletype and radio communication offices. A promising future for women has developed in this branch of airline work.

mantic barnstorming pilots is a thing of the past. Today's and tomorrow's airplanes take brains, physical fitness and plenty of concentrated technical study to "keep 'em flying."

The amount of money and time you can give to your preparation may influence your choice of an objective. You can ascertain in advance which jobs require college training or extensive preparation. If you are still in high school your teachers and librarians can help you find reading material of value; a part-time job in mechanical work, salesmanship, meeting the public, or electrical installation, etc., may give you experience that will assist you in deciding what to prepare for, and experience that will be helpful later.

Your physical condition is particularly important if you plan to work for an airline because many lines will not accept men who cannot pass certain physical requirements. Tests of sight and hearing are required, and radio operators and reservations salesmen must have clear voices and distinct articulation. The loss of a finger may not hamper you greatly as a mechanic, but it might prevent your employment. A noticeable physical handicap may bar your employment as a salesman, or in any meet-the-public job. Find out what your chances are before you waste time and money in preparation.

Flight training can be secured in a military school, or at those Government-approved civilian schools still operating. Commercial training at a civilian school would be for airline work but a careful selection would have to be made, otherwise the airlines you apply to may not consider your training as being the type they require.

One of the newer and profitable jobs in aviation is that of the airline meteorologist. This work has in recent years become of vital importance since the airlines have established their own meteorology departments to supplement the work of the Government weather service. Special airline meteorology courses are offered by certain aviation schools, and graduates of such courses generally have jobs waiting for them when they finish.

Another job that has increased in importance is that of the dispatchers who act as the key men in airline flight operations as they direct and co-ordinate all operations functions. They must understand and work with the problems of the pilots, meteorologists, passenger agents, reservations personnel, maintenance supervisors, radio operators, operations executives and the Government airways traffic control operators. The dispatcher is required to have previous experience as a dispatch clerk, or in airlines operations work, and he must pass an examination on Government regulations, airline operations data, meteorology, radio, airways aids, and navigation in order to obtain a dispatcher's rating.

Radio operators, also play an essential part in airline operations since the radio is used in contacting planes and ground stations. Some airlines use radio-telegraph (code) for station to station messages, and radio-telephone (voice) only for plane contacts. Other lines use radio-telephone exclusively. In addition to a good radio voice, the radio operator must have the proper type and class of Government radio operator's license.

High-school graduation followed by instruction at an aeronautical school having a radio course, offers the best procedure for obtaining a radio job because you will study some aviation subjects in addition to radio.

Radio operators at smaller intermediate stations frequently must be familiar with other duties such as: loading and servicing planes landing at the station; office routine, records, and correspondence, giving out information on air travel, making reservations, and selling tickets. Some airlines call such employees station attendants, rather than radio operators, and a man who has abilities over and above radio operation, may transfer later to his preferred specialty.

Airline radio maintenance requires men to handle various types of jobs: for example, the radio service mechanic checks the radio equipment and makes necessary repairs on the radio installations in the planes; the radio shop men handle equipment maintenance and overhaul, and new projects; and there are other men who take care of ground station installation and maintenance.

For the young man who is not interested in technical or mechanical work but rather in the sales and promotion phase of the industry, there are many fine opportunities in peacetime. Such jobs, generally known as outside salesmen, traffic representatives, counter salesmen, reservations salesmen and passenger agents, have practically no openings for men today because of the war's curtailment of airline schedules and the resulting surplus of personnel in this work.

After the war, the airlines must add new schedules, new services and new routes, and aggressively promote the sale of air travel again. Such public contact work requires high-school graduation at least, and two years or more of college are desirable. Recommended subjects for study in high-school include economics, typing, bookkeeping, public speaking, geography, English, and commercial law. Two years of a foreign language may prove useful as international air travel increases, and shorthand will be a handy thing to know at times. Actual business and sales experience in contacting the general public is a decided asset.

The specialized nature of many of the jobs in this field requires special training, such as is given in peacetime at one of the leading aviation schools, in air transportation and airline sales work, plus some instruction in aerodynamics, Civil Air Regulations, safety, navigation, airway aids, typing, operating procedure, air law, meteorology and radio operating practice.

Now let's change the subject and talk a bit about *you*. You think that you know the kind of a job you want in aviation, but are you sure that you are the right kind of an individual for the job? Too many times a fellow gets his heart set on a certain kind of a job and then finds before or after he gets it that it is not what he thought it would be and that he is not the right man for such work; that he does not have the right temperament and training for it.

You must pick the job that fits you; then train yourself for that job. In picking the job learn all you can about it, and about the company you want to work for. In trying to decide for what kind of a job to aim, or what school to attend, or what company to try to get employment with, be sure to read and study everything you can on the subject. Study the advertisements of the aviation schools in this magazine to see which ones seem to offer what you want, then write to

(*Continued on page* 165)

NIGHT FIGHTERS

The Hawker "Hurricane IIC," favored for night fighting, mounts four 20 mm. cannon and four machine guns.

by EDWARD KENNEDY

These pilots are the individualists of the RAF. They have become a legend of the North African front.

INCLUDED in the great air force striking hard at the Germans in the North African offensive are cat-eyed desert night fighters of the RAF.

This British squadron flying *Hurricanes* armed with four cannon has two tasks: One, to catch enemy night raiders and shoot them down; two, to harass the enemy on the ground.

They have been doing both with great success.

I visited the night fighters in the late afternoon. That is the proper time to call on night fighters. In the morning, they will be sleeping; at night they will be flying. This is one of the rules of desert etiquette which is learned from experience.

First of all, I wanted to check on popular notions about night fighters. One is that they eat special vitamin tablets so they can see better at night. Another is that they are not allowed to eat eggs because of a theory that the sulphur in eggs impairs night vision.

The squadron leader and the squadron doctor were standing together so I put these questions to them.

The egg legend is absolutely untrue, they said. All the flyers eat eggs for breakfast every afternoon. Vitamin tablets are left up to each night fighter. If he finds vitamin tablets make him see better and he can find the tablets, no one prevents him from eating them.

"There is no way of improving sight," the doctor said. "All that can be done is to prevent it from deteriorating."

And then the squadron leader came through with this real explanation of what makes a night fighter:

"If he has a good record and we can use him, he is accepted. The main thing is whether he likes night flying. If he does, you don't have to worry much about night vision. Most of us would never want to go back to day flying."

Night fighters are the greatest individualists among desert pilots. They strive for none of the close teamwork which means so much in bomber squadrons and even among day fighters. Each man is on his own, lurking around in the sky looking for something to shoot at.

He may be assigned to hang over certain areas where enemy raiders are expected. Or he may be assigned to areas on the enemy's side. Over there he looks for good targets such as a camp, a group of soft-skinned vehicles or a gasoline dump, comes down and strafes it with cannon shells and usually leaves fires behind. He also carries a single bomb for any target worthy of it.

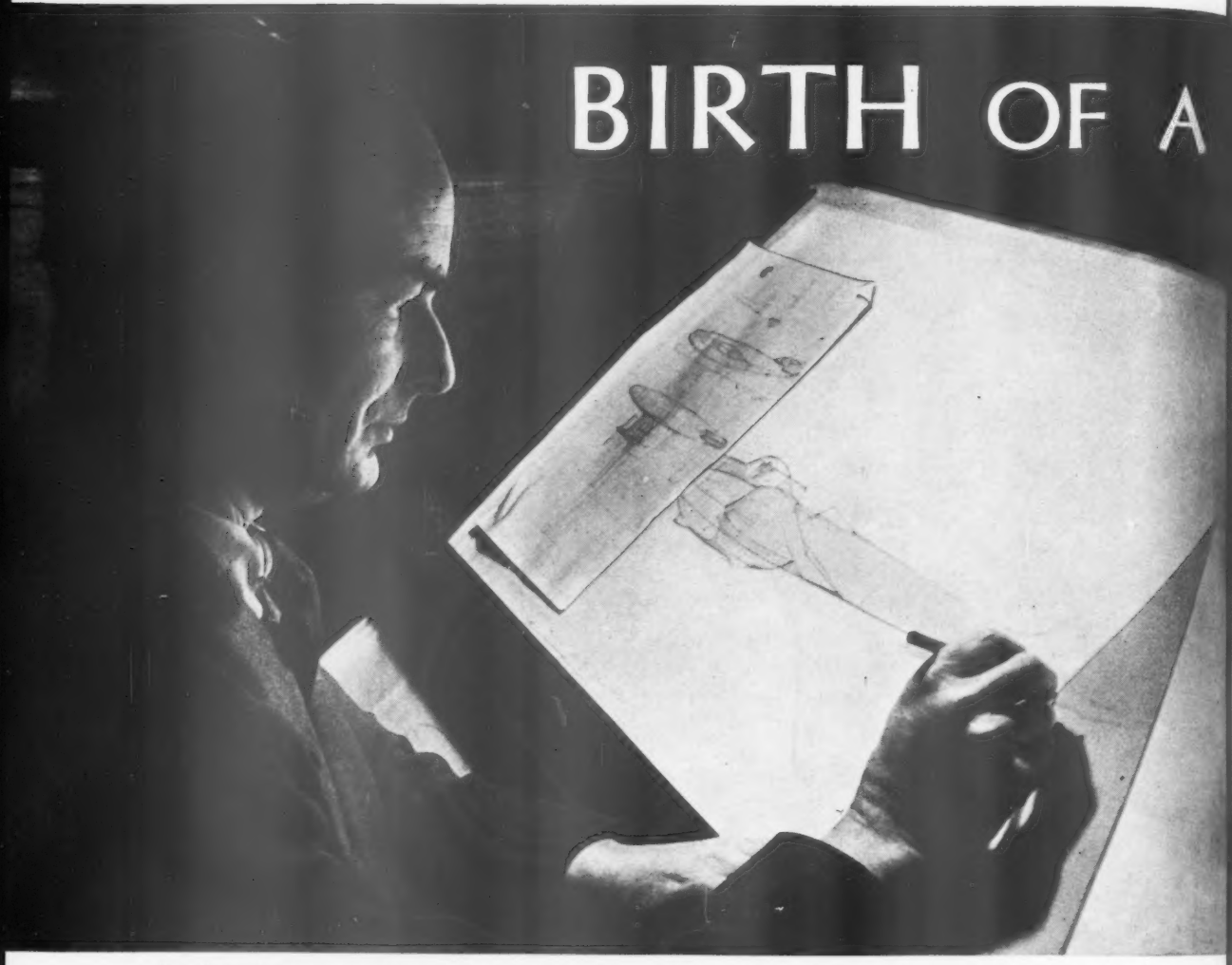
He may lurk over an enemy airfield until planes land, then dive on them.

Phases of the moon are very important and tactics are altered with its wax and wane. In full moonlight the night fighter must be more cautious. In the moonless period he has ways of finding targets.

It's fortunate that night fighters live on the earth rather than on Jupiter because that planet has nine moons, seven going in one direction and two in the other. This would make night fighting most complicated. END

Night fighter returns after a sortie over the enemy's lines.

BIRTH OF A



New designs engineer H. R. Hayes is a key man in bomber production. Design on board was sketched for this photograph only.

by J. I. WADDINGTON

Photographs from British Information Service

ONE of the reasons for Britain's superiority in the air over the Luftwaffe is the fact that Britain has never "frozen" her designs. While the Nazi has produced the Messerschmitt Me-109's and Junkers Ju-87's in great numbers, Britain's more recently designed and modified *Spitfires* and *Hurricanes* have demonstrated their superiority in speed, maneuverability and fire power.

The British policy of fairly frequent changes of type has one disadvantage which must be weighed against the individual superiority of British aircraft—any change in an aircraft type slows up production.

Britain's theory of changing types has stirred up some talk between the designers and the production engineers. The designer wants his aircraft to have the most recent improvements incorporated into its design, while the production engineer wants as few changes as possible so that he may improve and speed up his production. Britain so far has been able to strike a balance between these two oppositions.

The layman often hears that a certain factory is non-productive during a change-over from one type of production to another. He cannot understand why the factory cannot stop the manufacture of one type one night and the next morning begin construction on another. For him to understand this lag in production, it is most necessary for him to understand the organization of a factory necessary to produce a new aircraft.

When an aircraft factory takes over the job of putting out a heavy bomber like the Handley-Page *Halifax*, when before they had manufactured light ones, all designs of the plane are completed—but not the production planning.

The parent or design-drawing firm submits to the planning office of the manufacturer all the actual drawings of the aircraft (which in some cases may be as many as 18,000 or so in number).

Poring over these drawings, the production office staff consider their interpretation for actual use in the shops. They are analyzed for different production processes, the designing of jigs, tools and other fixtures on which parts and assemblies are made and finally assembled into a complete aircraft. They must also draw up specifications on all types of materials used in the aircraft and the quantities of these materials which will be needed.

One of the first jobs of the production crew is to break down the drawings under four different headings:

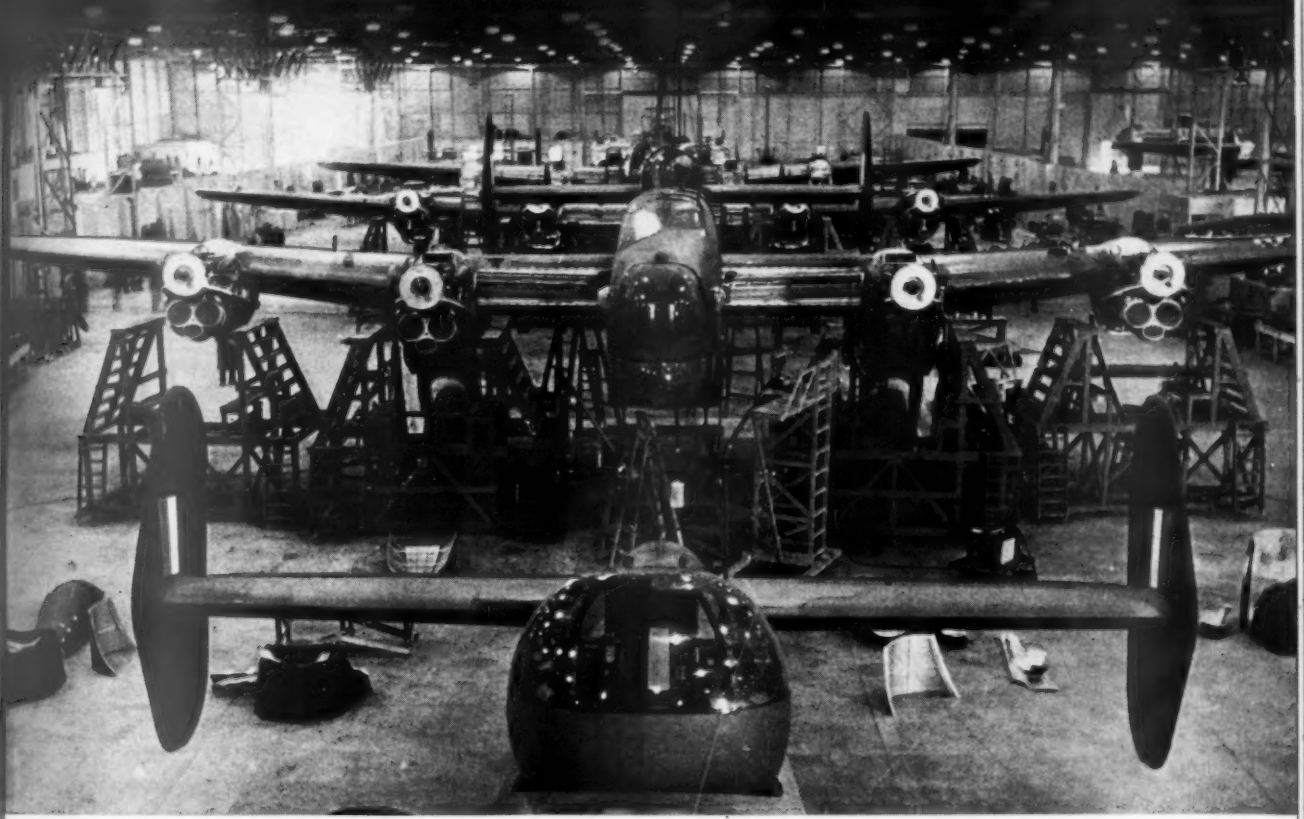
1, *Planning Sheets:* defining the operations necessary for the manufacture of details, sub-assemblies and assemblies; and

2, *Tool Instruction Sheets* which are issued for each tool or jig required for manufacture; and

3, *Parts List* which is a schedule of

A BOMBER

Thousands of drawings go through an intricate process before they form a new "Halifax" for the RAF.



Wings, nose, tails and engines are all in place as this "Halifax" nears completion. The engines are Rolls-Royces.

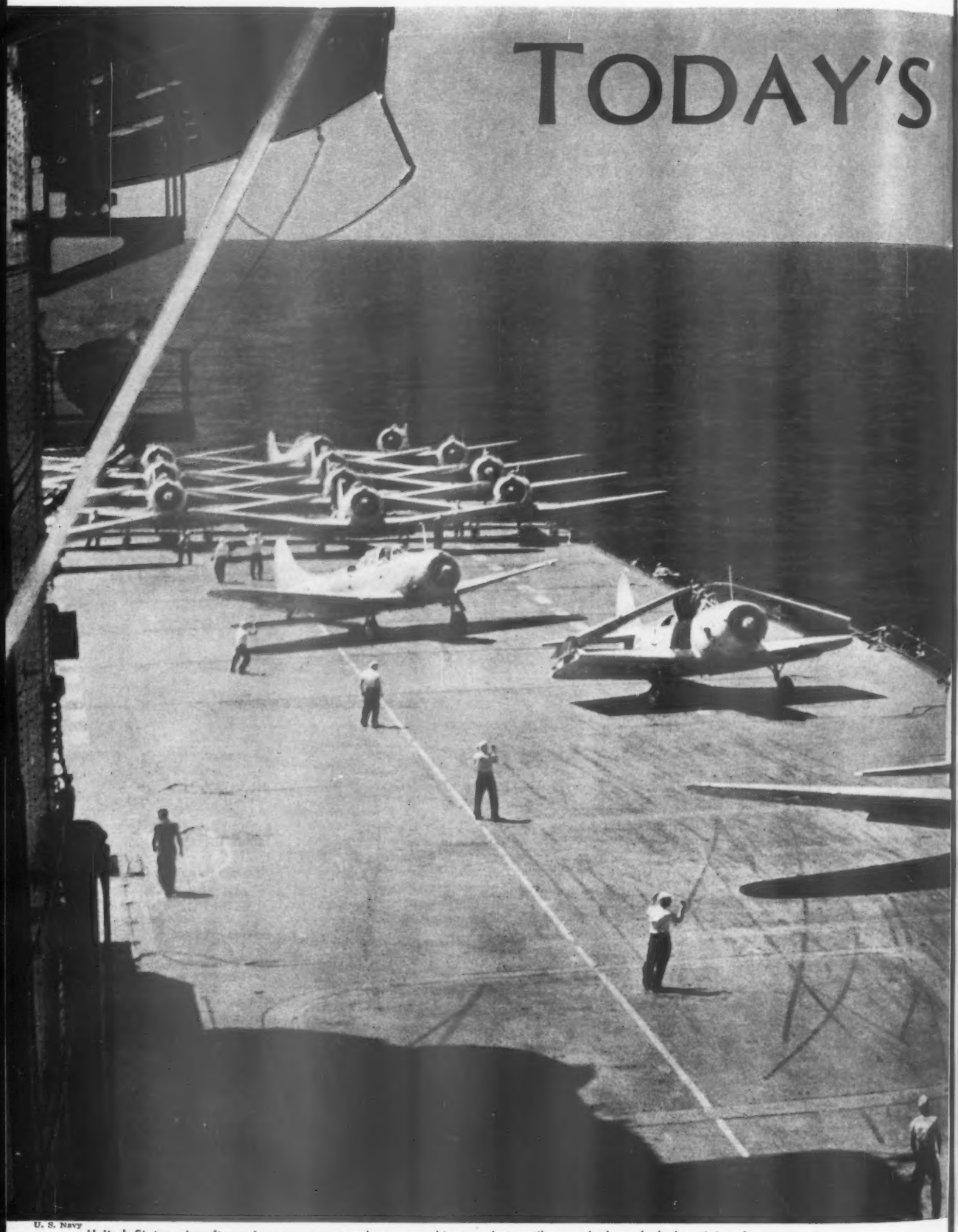
the details and sub-assemblies required to produce a complete modification; and 4, *Material Schedules* which are a summary of all the quantities and specifications of all the necessary raw materials.

Before and after all this activity in the production department, the Ministry of Aircraft Production has suggested a program of production for the factory based on its previous capacity and asks for an accelerated quota of aircraft per month up to a certain maximum. The Ministry's suggestions are discussed by the heads of the material, production, planning and material control departments and are either agreed on or amended before the final agreement is drawn up.

During this discussion, the factory men consider in detail the amount of work involved in tooling, the manufacture of details and sub-assemblies and other factors involved in preparing a plane to "fly-away." Also discussed is the question of

(*Continued on page* 164)

"Halifax" production involved 28,000 tools and jigs and 18,000 designs.



U. S. Navy

United States aircraft carriers carry more planes per ship ton, but until recently have lacked antiaircraft armament.

AIRCRAFT CARRIERS

by BRUNO GRUENWALD

Naval architects still must strive for the carrier design possessing more tactical efficiency.

TACTICALLY the carrier is very limited in efficiency, due to its complicated and unusual construction. When a carrier is designed, the naval architect is required to provide large underdeck hangar space to allow for aircraft storage. In providing this, the ability to divide the hull into numerous compartments is minimized. Consequently it becomes difficult for a damage control officer to localize torpedo hits. The carrier *Lexington* was able to absorb two torpedo hits on one side because originally she was laid down as a super battle cruiser and therefore her hull at the waterline was in the form of numerous compartments so prevalent in warships of her type. Her conversion did not take place until a good portion of her hull had been completed. Although she subsequently sank it was not due to the torpedo holes but rather to escaping gasoline fumes that exploded. It still remains a mystery as to why the fumes remained undetected.

Hit by bombs and shell fire, a carrier can be put out of action by having its main flight deck holed, preventing aircraft from taking off or landing.

The cry for small carriers, with the idea in mind that if one was sunk the loss would not be as great, has led to a peculiar situation. Although the small carrier advocates' logic is strong, they overlook the possibility of creating carriers twice as vulnerable as they are today. The smaller a carrier the sooner a list will develop from torpedo hits, thus preventing airplanes from using the flight deck. Also, a shell or bomb hit on a smaller deck is more liable to block the runway because of its comparative narrowness. On large carriers, holes on the main deck might not seriously impair flight deck use. As the *Lexington* photographs indicated, two torpedoes merely gave her a very slight list. Proof of these assumptions is seen by noticing that all our new carriers are to be of some 25,000 tons and Britain's new carriers are to be of 23,000 tons. The new small carriers are converted freighters and hence their original tonnage governs the size of the carrier to-be.

Aircraft carriers are also dependent upon weather conditions, more so than other warships. A high sea can prevent a carrier from releasing its planes, since a roll is developed, especially on a high-hulled ship. Again, the small carrier loses efficiency, for the smaller the ship, the quicker and greater the roll. If a heavy rain, sleet or snowstorm is encountered, aircraft again would be useless. The sinking of H.M.S. *Glorious* by the German battle cruiser *Scharnhorst* in a snowstorm off Norway at the beginning of the war was too quickly forgotten.

A carrier is also required to turn into the wind to release its planes. Submarines or attacking destroyers, torpedo boats or motor torpedo boats co-operating with an enemy fleet could frustrate any attempts to turn into the wind. As yet the latter tactics have not been reported employed.

A more concise knowledge of the limitations and tactics of the carriers is possible if each individual class is studied and analyzed. Although there are basic rules followed by all types of warship and aircraft, each type has its own peculiarities.

When the German architects endeavored to design a carrier, they proceeded to work with the thought in mind of developing a carrier that would be suitable for raiding expeditions rather than for fleet operations. The idea was far from a new innovation, for our *Saratoga* (originally laid down as a battle cruiser) and France's *Bearn* were designed with large guns to supplement the aircraft. The advantage the Germans possessed was that their ship could be designed with the knowledge obtained by studying previous designs. After omitting the faults in the old designs they would proceed with new constructional features incorporated within the hull.

The odd feature of these ships is that, although they displace some 19,250 tons, they only carry 40 aircraft. The reason for this is that they mount unusually strong gun batteries and undoubtedly have their hulls subdivided into numerous compartments, more so than Allied or Japanese carriers. This is done so as to localize torpedo hits.

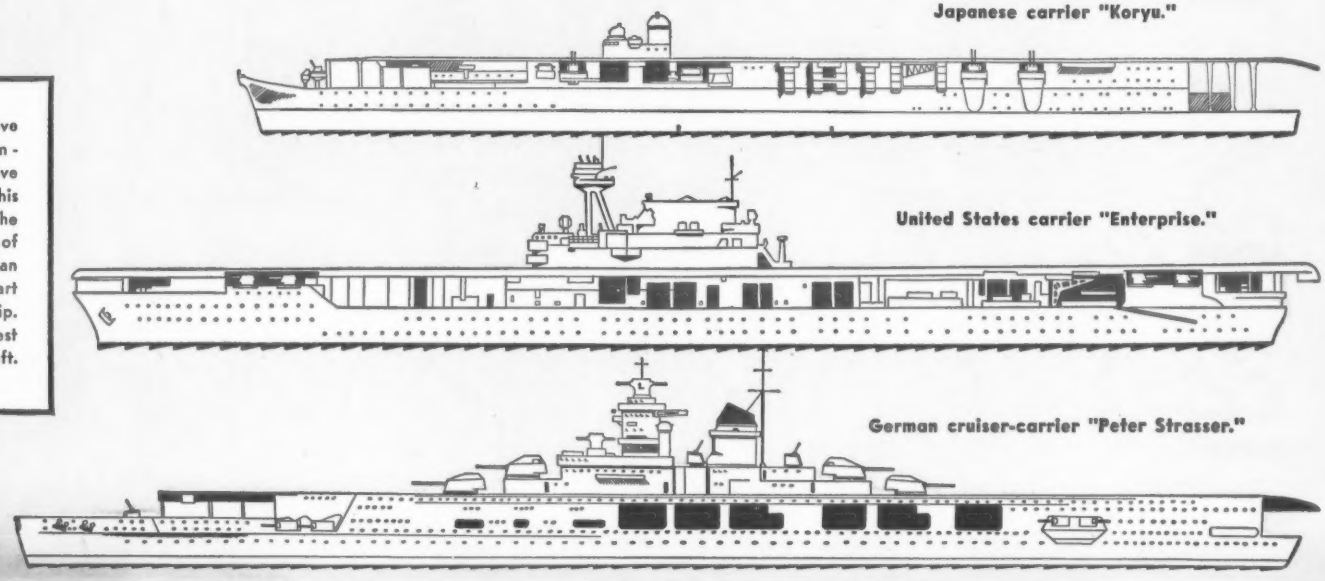
Had this carrier been for use with a fleet, aircraft would have been the primary stipulation, but the ship was designed to operate independently. The necessity for a cruiser to be taken along for support was eliminated by arming her with enough guns to equal that of the

DATA CHART OF ALLIED AND AXIS AIRCRAFT CARRIERS

Name and Class	Launched	Tons	Length	Beam	Draught	Horsepower	Speed	Armament	Aircraft
ENTERPRISE CLASS									
Enterprise	Oct. 3, 1936	19,900	809.5 ft.	83.2 ft.	21.6 ft.	120,000	34 knots	8 5-in., D.P.	81 to 85
Hornet	Dec. 14, 1940	19,900	809.5 ft.	83.2 ft.	21.6 ft.	120,000	34 knots	8 5-in., D.P.	81 to 85
ILLUSTRIOUS CLASS									
Illustrious	Apr. 5, 1939	23,000	753 ft.	95 ft.	24 ft.	110,000	31 knots	16 4.5-in., D.P.	60 to 70
Victorious	Sept. 14, 1939	23,000	753 ft.	95 ft.	24 ft.	110,000	31 knots	16 4.5-in., D.P.	60 to 70
Formidable	Aug. 17, 1939	23,000	753 ft.	95 ft.	24 ft.	110,000	31 knots	16 4.5-in., D.P.	60 to 70
Indomitable	Nov., 1939	23,000	753 ft.	95 ft.	24 ft.	110,000	31 knots	16 4.5-in., D.P.	60 to 70
Implacable	Building	23,000	760 ft.	95¾ ft.	22⅓ ft.	140,000	32 knots	16 4.5-in., D.P.	60 to 70
Indefatigable	Building	23,000	760 ft.	95¾ ft.	22⅓ ft.	140,000	32 knots	16 4.5-in., D.P.	60 to 70
GRAF ZEPPELIN CLASS									
Graf Zeppelin	Dec. 8, 1938	19,250	820′ 3″	88′6″	18′4″	100,000 ★	32 knots	16 5.9-in. and 10 4.1-in.	40
Peter Strasser	Jan., 1940	19,250	820′ 3″	88′6″	18′4″	100,000 ★	32 knots	16 5.9 in., A.A.	40
KORYU CLASS									
Koryu	Sept., 1939	10,050	688′6″	68′4″	16′6″	60,000	30 knots	12 5-in., A.A.	30 to 40
ZUIKAKU CLASS									
Zuikaku	Nov. 27, 1939	17,000★	800 ft.★			50,000	30 knots	12 5-in., A.A.	45

★ Approximate.

The tabular summary given above graphically illustrates the comparative characteristics of the five main carrier classes active in this war. The scale drawings to the right show the relative lengths of German, Japanese and American carriers. A glance at the chart tells the capacity of each ship. The Koryu, though the smallest carrier, carries heavy antiaircraft.



average light cruiser, thusly should she encounter a small enemy surface ship in weather not permitting the utilization of her aircraft, her guns could ably deal with her opponent. The ship was undoubtedly particularly designed for attacking convoys. Aircraft could prevent the scattering convoy from succeeding to escape. Thusly, should this carrier reach the Atlantic she would form a particularly dangerous vessel.

England's new carriers of the *Implacable* and *Illustrious* classes are improved versions of the now sunken *Ark Royal*. The two classes are almost identical in appearance, but performance and dimensions vary slightly. The most outstanding feature of these ships is the mounting of a great many large caliber antiaircraft guns. Beside the standard 4.5 inch dual purpose guns, numerous smaller pom-poms are located at vantage points guarding all approaches to the ship. The antiaircraft armament of these ships is the largest ever carried on carriers. Our ships of an older design mount merely eight guns.

Before discussing the Japanese carriers the reader should be reminded that because of hostilities (and Japanese secrecy) it is very difficult to obtain proper information regarding names of existing ships, those being built and those that we have destroyed. The Japanese have no definite nomenclature for their ships so their possible names cannot be ascertained. However the classes listed are of the most modern type Japan have (or had) in service.

The unusual feature of the Japanese carriers is that their aircraft capacity is extremely low. The 17,000 tonner of the *Zuikaku* class carries 45 planes, while the sunken 14,700 ton U. S. carrier *Wasp* carried 72 planes. This may possibly indicate that the Nipponese carriers are better protected with armor as well as having more antiaircraft guns. Or it may simply mean that they lack proper knowledge in designing carriers.

The older carrier *Koryu* is some 7,000 tons lighter and yet carries but five to 15 planes less. All this is not as odd as it may seem, for the complement of planes allotted to the carrier may not be fighters and torpedo planes but the number of bombers carried by the ship. The Japanese carriers have a very small island superstructure, thusly twin-engined bombers are capable of operating from their decks.

In the Black Sea, Russia supports her fleet with the little known of carrier, *Stalin*. The 9,000 ton carrier can attain a 30-knot speed and carries 22 fighters.

This Russian carrier has no need for carrying torpedo bombers because of the lack of naval opposition (except submarines) in the Baltic. The fighters provide a continual umbrella over fleet operation. These few planes many times meant the deciding of an engagement in the Black Sea between German aircraft and Russian naval units.

In the Baltic, Russia has for several years attempted to complete two carriers. Although the German bombing has slowed up progress at the Leningrad yards, work is undoubtedly continuing. These carriers when completed will lead the Northern Russian fleet against the German surface units in the Baltic. It therefore is self-evident why the Germans wish to halt progress. Control of the Baltic is at stake.

The United States carriers are the best in carrying capacity, but lack sufficient antiaircraft armament of large caliber. The best we have existing is that of the *Enterprise* class. One, the *Hornet*, was newer and slightly modified. Recent launching photographs of the new ships of the *Essex* class bear a great resemblance to the *Enterprise*, which suggests the success of the latter.

[When the Japs struck December 7, keels had been laid for 11 big carriers. Two more were authorized immediately following the attack and last July Congress sanctioned the building of 20 more. Four of the first 11 have already been built and others are already on their way in expediated building schedules. There may still be more carriers afloat or building whose existence has not yet been announced by the Navy.

[While these carriers, announced and unannounced, have been already launched, it is not likely that any have seen action as several months are required once the ship is in the water for fitting it out for service.

[While the U. S. has lost four carriers in action, shipyards are steadily building replacements which already have proved to be much better flat-tops than the carriers they replaced.—Ed.]

In conclusion it is well to ask again, is it not more logical, and economical, to build large carriers rather than small carriers, in view of the shown superiority that all the large ships included in my discussion show over small ships? As events of the war substantiate, all carriers destroyed by aircraft were of the smaller type. Those who question the sinking of the *Lexington* should be aware of the fact that although she was hit by two torpedoes, she proceeded without a list or at a reduced speed.

The struggle for sea supremacy today becomes more and more important, with the airplane obtaining a greater role, day by day. But were it not for carriers to transport these deadly weapons, the modern fighter and torpedo plane would be effective only within a relatively few miles of its base.

END

Caught in a snowstorm off Norway on June 8, 1940 by the Nazi battleships "Scharnhorst" and "Gneisenau," the carrier "Glorious" was sunk. The bad weather kept her planes from taking off. This picture made during 1937 maneuvers.

Acme

This Consolidated "Commodore" was converted into a classroom for navigators.

Training ARMY NAVIGATORS

by EDWARD J. RYAN

Photographs from Pan American Airways

Army planes reach their objectives in all parts of the world as a result of a 1940 "experiment."

A LONG time before December 7, 1941—15 months to be exact—50 U. S. Army Air Force navigation cadets marched into classrooms at the University of Miami to become the guinea pigs in a fighting arm that is hitting the enemy "wherever and whenever they find him."

The then diminutive Army Air Force was just beginning to spread its wings when these guinea pigs went under the microscope. From their vantage points on the war fronts in Europe and Asia, Air Force observers not only were witnessing the potency of air superiority, but were learning that air navigation was vital to any sort of aerial combat. They were learning, too, that navigation had become a specialized job; the day of the pilot-navigator was over.

The role of Air Force navigator was non-existent when the first Army cadets marched across the Florida campus on that hot August day in 1940. Twelve weeks later the Air Force commissioned its first officer navigators. An experiment became the cornerstone of a vast training program.

Since that day this school has turned out most of the young officers riding in the navigator's hatch of bombers and transport planes in every theater of this global war. When Japan stabbed Pearl Harbor in the back, this school's former pupils were the first navigators to go into action.

For nearly three years, through peace and into war, this program has been carried on and expanded, a monument to the successful co-operation between the Air Force and commercial aviation. For 18 weeks the Air Force cadets study under the civilian experts who pioneered aerial navigation on Pan American Airways' over-the-water routes across the Caribbean, the Pacific and then the At-

lantic. From this school has been drawn the nucleus for the staffs of instructors at the four huge schools maintained by the Flying Training Command.

The story of this co-operative setup goes back to a brisk day in 1939. Ensconced in his cubicle behind the pilot's compartment, Charles J. Lunn was busy charting a Pan American *Clipper's* course from New York to Lisbon.

An intent U. S. Army officer peered over his shoulder, watched closely as Lunn worked over maps and charts. The *Clipper* navigator's ability to hit tiny mid-ocean spots "on the nose" started a train of thought for the observant Lieut. Gen. Delos C. Emmons.

"How many men can you teach aerial navigation?" the general finally asked. Lunn looked up from his charts. "As many as you can get within the hearing of my voice," he replied.

Navigator and general parted at the *Clipper* door in Lisbon. To Lunn it was a closed incident on another transatlantic flight. But the germ of an idea had taken root in General Emmons' mind during that aerial tete-a-tete.

A few months later the War Department asked Pan American Airways to train an experimental class in aerial navigation. The company promptly set up the Pan American navigation section. Classrooms were borrowed from the University of Miami in Coral Gables, and four flying boats from the Latin American routes were converted into "flying classrooms."

Assigned as instructors were the veterans of Pan American's international commercial operations. Appropriately enough, the task of chief instructor fell to Lunn.

The job of running the navigation section is a divided but not a divergent one. Lunn is concerned only with teaching navigation. The cadets, housed in what once was a girls' dormitory, are under the command of Capt. Frederick R. Merritt, commandant of the Army Air Forces Training Detachment. From its own ranks, the Air Force assigns picked men for the specialized training.

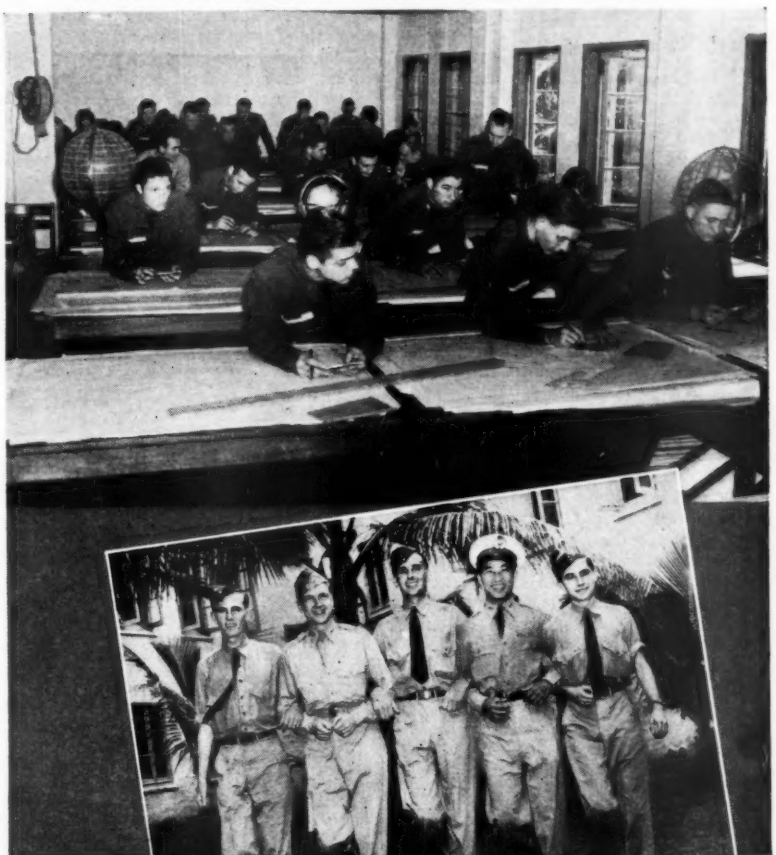
When they aren't in classes or studying, the cadets follow a life geared to regular Army discipline. They aren't permitted to forget they're in the Army. Dovetailing these scholastic and military requirements requires close co-operation between the Army and civilian heads. Captain Merritt and Lunn have succeeded in working it out without damaging too many toes.

Into 350 class hours the Pan American instructors have crammed an intensive course. For six weeks the cadets get navigation and meteorology theory in the classrooms. When they have mastered the fundamentals, those who survive that first period are ready for their practical experience in the "flying classrooms." The entrance of classes is planned so

(*Continued on page* 163)

Using the figures given him by companion at the drift indicator, navigation cadet (right) solves drift problem with the aid of flight computer.

Cadets (below) receive six weeks of navigation and meteorology theory in classrooms before they are ready for practical experience in "Commodore."



Typical of its international character is this group of flight students, including cadets from England, New Zealand, Argentina, China and the United States.

LONDON SURVEY

by PETER G. MASEFIELD

An English authority discusses the aerial offensive plans of United Nations airpower

Mr. Masefield worked as a designer at the Fairey Aviation Company before he embraced the profession of his cousin, John, Great Britain's poet laureate, and embarked on a career as a writer. His bent for technical details led him to his present post as the technical editor of "The Aeroplane." He is also air commentator for the London "Times."

THE many people on both sides of the Atlantic whose particular interest is the combat performance of Allied and Axis aircraft have been presented with much new material for study recently. The big Boeing and Consolidated bombers of the United States Army 8th Air Force, based in England, have shown their paces over Germany in daylight, North American *Mitchells* (B-25Bs) and Lockheed-Vega *Venturas* (B-34s) of the RAF have been over France in daylight for the first time, while de Havilland *Mosquitoes* have visited Berlin. The Luftwaffe has replied by sending into action some of the new Messerschmitt Me-210 fighter-bombers, several of which have fallen to the guns of the Hawker *Typhoon* fighters, also in action for the first time. Taken all round the technical interest packed into recent weeks has been great.

European weather is one of the chief factors which influence the course of bomber or fighter missions from England at this time of year. Rarely is there a day without cloud. Sometimes there will be as many as three or four unbroken layers of cloud between 3,000 and 20,000 feet. During the past year the RAF has taken advantage of these conditions to dispatch more than 3,000 aircraft sorties over Germany in daylight. Although these attacks have been very successful in holding up production by sending workers to shelter and have been made with small losses, no great weight of attack has been put on any single target in daylight except in about half a dozen instances.

By carefully choosing their weather the bombers of the 8th Air Force have begun to increase the weight of daylight attack. The experience they gained on the "nursery slopes" over France is now being turned to good account over Germany. Although at the time of writing the American crews have been over Germany only twice, so that too hasty conclusions should not be drawn, the results at present look promising for the future when the greatly augmented weight of attack, promised by General Andrews, materializes.

Having had the privilege of flying in one of the 8th Air Force's B-17Es and having discussed these longer raids with pilots who have been on the two missions over Germany, one can appreciate both the possibilities and the tactical problems involved. There is no doubt that these longer raids are tough propositions. No one would minimize the strength of the defenses or the quality of the Nazi opposition. Yet the American bombers, in shooting down 22 enemy fighters for the loss of three on the first raid over Wilhelmshaven, and 25 for the loss of five on the second raid over the Ruhr, have shown that they can give better than they take.

The fine defensive armament is the thing that strikes one most of all about the *Fortress* after flying in it. In particular the ball turret under the belly of the fuselage is tremendously effective. We in Britain have unfortunately neglected the qualities of the 0.5 inch machine-gun, a neglect which the *Fortress* and *Liberator* have fully shown up. So far, in all operations from England, the United States Army 8th Air Force has destroyed 236 enemy fighters for the loss of 56 bombers and eight fighters—a ratio of nearly four to one in favor of the Americans, a ratio which must be giving the Luftwaffe a severe headache. In the ratio of air crews lost the picture is not quite so good; the Americans have lost 566 men against about 240 enemy airmen, not counting those who may have escaped by parachute. Even so the American bomber losses average only some five per cent of the sorties, which in daylight is about the same as that of the RAF's night attacks.

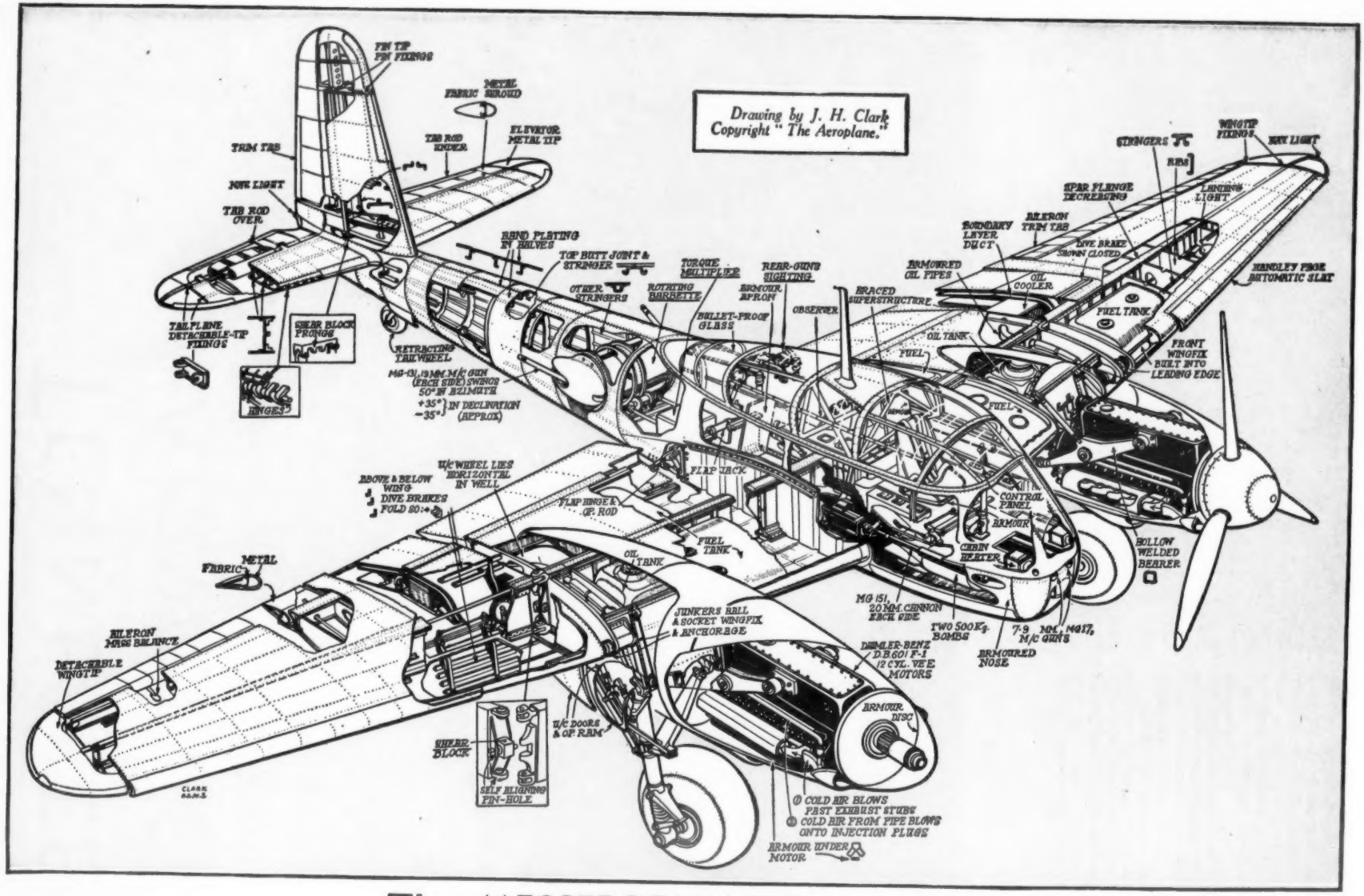
Taken all round the American contribution seems likely to be a most valuable step towards that ideal of the 24-hour offensive against the Reich.

Here, in England, the peculiar conditions of the air war at present are developing specialized tactics on both sides

(*Continued on page* 161)

Firepower of Allied and Axis planes as shown by relative weight per minute.

AIRCRAFT	ARMAMENT	TOTAL WEIGHT OF FIRE ALL GUNS LB/MIN	WEIGHT OF FIRE POSSIBLE AGAINST ONE TARGET LB/MIN
Boeing B-17E	twelve .50 caliber guns one .30 caliber gun	1,185	580
Bristol *Beaufighter*	four 20 mm. cannon six .303 caliber guns	815	815
De Havilland *Mosquito*	four 20 mm. cannon for .303 caliber guns	760	760
Messerschmitt Me-210	two 20 mm. cannon two 13 mm. cannon two .311 caliber guns	667	532
Hawker *Hurricane IIc*	four 20 mm. cannon	650	650
Focke-Wulf Fw-190A3	four 20 mm. cannon two .311 caliber guns	623	623
Grumman *Wildcat*	six .50 caliber guns	580	580
Supermarine *Spitfire IX*	two 20 mm. cannon four .303 caliber guns	445	445
Bell *Airacobra I*	one 20 mm. cannon two .50 caliber guns four .30 caliber guns	422	422
Avro *Lancaster I*	ten .303 caliber guns	275	220
Messerschmitt Me-109F1	one 20 mm. cannon two .311 caliber guns	268	268



The MESSERSCHMITT Me-201A1

This drawing was made in England from a captured Me-201A1, Germany's newest fighter-bomber.

TENNESSEE'S AIRWOMEN

by GENE SLACK

Photographs by Ed Clark

Ten girls polished their wings to become instructors of air cadets.

The lady flyers put away their powder puffs and gassed and serviced planes during their training.

EVER since the day Napoleon appointed a woman as his chief of air service there has been controversy as to women's place in aviation, and especially in the actual flying end of the business. In the summer of 1941, when women were taken out of the Civilian Pilot Training Program (now known as the War Training Service) courses, the argument reached a higher pitch than any propeller ever achieved.

Last fall the Tennessee Bureau of Aeronautics, with characteristic initiative where aviation is concerned, decided to settle the question once and for all by opening a research school to train 10 hand-picked women flyers as instructors. Thus Tennessee's Aviation Research Instructor School for Women was conceived —and the successful graduation of the 10 chosen women in February proved that Tennessee had once again paved the way in a vital new aviation field.

How vital may be proved by future developments forecast on the occasion of their graduation here by C. I. Stanton, Civil Aeronautics Authority administrator, who declared:

"It is my opinion that, since women have always excelled in instructing and have done most of the teaching of our nation, this should be their natural function in aviation.

"Our problem," he added, "is to give the 1,000,000 boys who will graduate into the draft each year flight training. I believe we should train at least 200,000 of them each year. To do that, we shall need at least 5,000 women instructors."

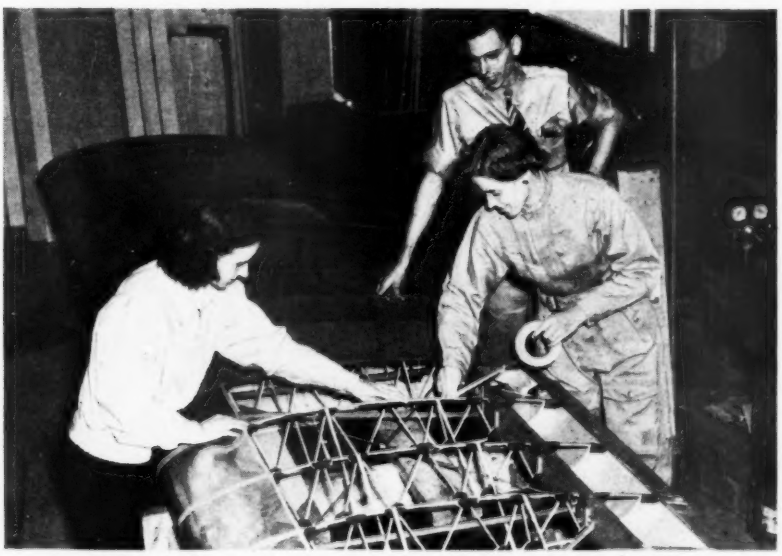
Then he added a justified pat on the back for Tennessee: "At any rate, you are pioneers in the very best Tennessee tradition."

The Tennessee school was in truth pioneering. There had been nothing like it before, and the men responsible had to start out cold.

First of all, W. Percy McDonald of Memphis, chairman of the Bureau and an aviation pioneer in Tennessee, cast about for some one with a feminine viewpoint, a knowledge of aviation and a fine hand for management to help set up and supervise the program. He finally per-

The dining room of the lady pilot's dormitory was turned into a study hall. Here a class is being held in aerial navigation.

Forty-one-year-old Phoebe Fairgrave Omlie was one of the first women granted private flying license and first to earn airplane mechanic's license. She has been parachute jumper, instructor and promoter of many aircraft shows.



Working in the hangars, the women learned engine repair and rigging.

Each morning at seven, the girls reported on the lawn for calisthenics.

suaded the Civil Aeronautics Administration to loan him Phoebe Omlie, senior private flying specialist.

The Omlie-McDonald combination is nothing new to Tennesseans. The first airport in the state was built at Memphis in 1925, by Vernon and Phoebe Omlie and McDonald. They grubbed and toiled together to bring the first runways from the rough terrain. They started the first free flight schools in Tennessee in 1938. They gave the state its Aviation Act of 1937, which turns aviation gasoline tax money back into various aviation channels.

When Tennesseans heard of the renewed partnership in the airminded firm

(*Continued on page* 128)

RCAF PILOT POOL

by BRUCE KEITH

Canada's Air Cadet League is providing a huge support line of future pilots by an organized system of pre-flight training.

A typical Air Cadet is Andre Trudeau, 16, of Montreal. His training will take two years.

Study of auto engine teaches rudiments of internal combustion.

WHILE pilots, gunners and wireless men of the Royal Canadian Air Force form a front line of fighting airmen in the battle skies of Europe, Africa and the Far East, citizens of Canada have rallied together to establish a support line of future pilots behind them.

Flyers of the last war did it. The men who flew the Spads and Sopwiths could see that a great army of aviation-trained boys of 15, 16 and 17 would be needed to back up today's Canadian air heroes of 19, 20 and 21, many of whom were included in the "few" who saved Britain in the autumn of 1940.

It takes nearly a year to train a good fighter pilot in the RCAF. But if boys are given intensive training in their later high school years, the World War I flyers reasoned, they will be able to skip through training schools in much less time and will be better pilots when they first face the enemy.

Thus it was that veterans of the last war came together in Ottawa and formed the Air Cadet League of Canada. Their avowed purpose was to train teen-aged boys in aviation and thereby make them more capable recruits for the RCAF. As a by-product, of course, the boys could be expected to benefit if they adopted aviation careers in the post-war world.

Today well over 17,000 Canadian boys 15 to 18 years old are studying in a country-wide network of training squadrons. Their officers and instructors are mainly veterans of the last war, although in any given community almost all the adults are persuaded to support the training project in some way.

A remarkable feature about the League is that it is a civilian organization doing an air force job and doing it well. It is financed by gifts and donations of money

Film actress Anna Neagle, who aided in cadet financing, admires Me-110 model.

Cadets are required to take 30 hours of gun drill and the same period of physical training as an integral part of their basic aeronautical instruction.

solicited by the ever-active veterans. Its officers are civilians and its teachers are civilians.

By now the RCAF has taken the training program under its wing somewhat and provided a syllabus of training and much of the necessary equipment. But the program is still a fine example of common people in a country at war rallying to provide their fighting forces with the most essential of all commodities—skilled manpower.

What type of aviation training do the boys take? As finally framed, the Air Cadet force of instruction is almost identical to the initial training school work given a new aircrew recruit in the RCAF in the first two months of his training. That gives the Air Cadet squadron a target at which to aim. If they hit it squarely, the RCAF will quite likely give Air Cadets a two-month boost along the way to graduation as airmen with wings.

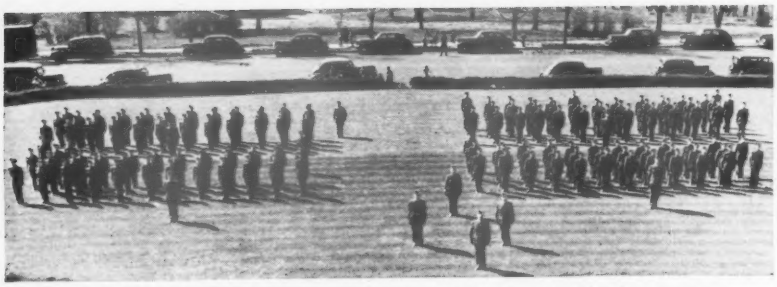
Air Cadet League men got their movement off on the right foot by enrolling the King's representative in Canada—His Excellency the Right Honorable Earl of Athlone—as patron of the organization. Air Marshal W. A. "Billy" Bishop, V.C., was made honorary president.

Dynamo of energy for the Air Cadet training program in Canada is a national board of civilians, composed mostly of World War I flyers, representing all provinces. Having constructed a framework for the organization they filled it in with civilian committees in each province which in turn organized local community groups of adults. In turn again, these local groups—the corner drug store man, the town doctor and lawyer and dentist—would call together 25 or more young men in their community who wanted aviation training. Schools, church basements or town halls were rented. Instructors were called in, and enough money was raised to pay for RCAF-style uniforms and training equipment.

Canada has now begun to scrape bottom in the barrel of her manpower reserve, and the training of Air Cadets has become a crucial undertaking. Group Capt. D. C. M. Hume, formerly director of technical training for the RCAF, has been loaned to the League as national director. After a cross-country inspection trip he predicted that the organization can expand to a force of 50,000 during 1943.

Just what the movement means to the Canadian government was outlined re-

Cadets studying "Harvard" trainer as part of 12-hour course in airmanship.



Precision in ground drills, as in flying, is part of the indoctrination course.

Rifle range practise is popular, but cadets also learn gun care and cleaning.

Wing construction and operation of aircraft controls is thoroughly explained.

cently by Air Minister C. G. Power, Minister of National Defense for Air:

"I cannot too strongly emphasize the importance of this training for our future flyers. It is my sincere hope and fervent prayer that they may fly the airways of peace. But I know too that if the time comes when they must take the places of their fathers and their brothers in defense of the cause of freedom, they will be staunchly true to the tradition which those fathers and those brothers are daily establishing in the skies.

"Our great British Commonwealth Air Training Plan is in full operation. It is capable of the greatest acceleration. And so, in the months of struggle still ahead of us, the problem of manpower will become increasingly critical. The Air Cadets of Canada can make a major contribution to the solution of that problem, and, at the same time, equip themselves materially for peacetime occupation in the aviation industry."

How does the Air Cadet League—a civilian organization—dovetail its program with the RCAF—a military body? That was the problem that confronted the country from the start. Now it has been settled by mutual adoption of a 10-point program.

1. Responsibilities of the League are to continue to have a sound organization of national headquarters and provincial committees; aim for a vigorous nation-wide drive for new squadrons; continue to help arrange for officers and instructors and adult sponsors of squadrons; to aid when possible with financing of local committees; to publish the official magazine, "Canadian Air Cadet"; and to

(*Continued on page* 146)

Color Section

The pages following introduce a new monthly feature section of Flying. Outstanding aviation pictures, military and civil, will be presented as a colorful, dramatic record of a winged world.

High point of the program is actual contact with planes, such as these "Harvard" trainers at St. Hubert Airport, Montreal.

TRAINING

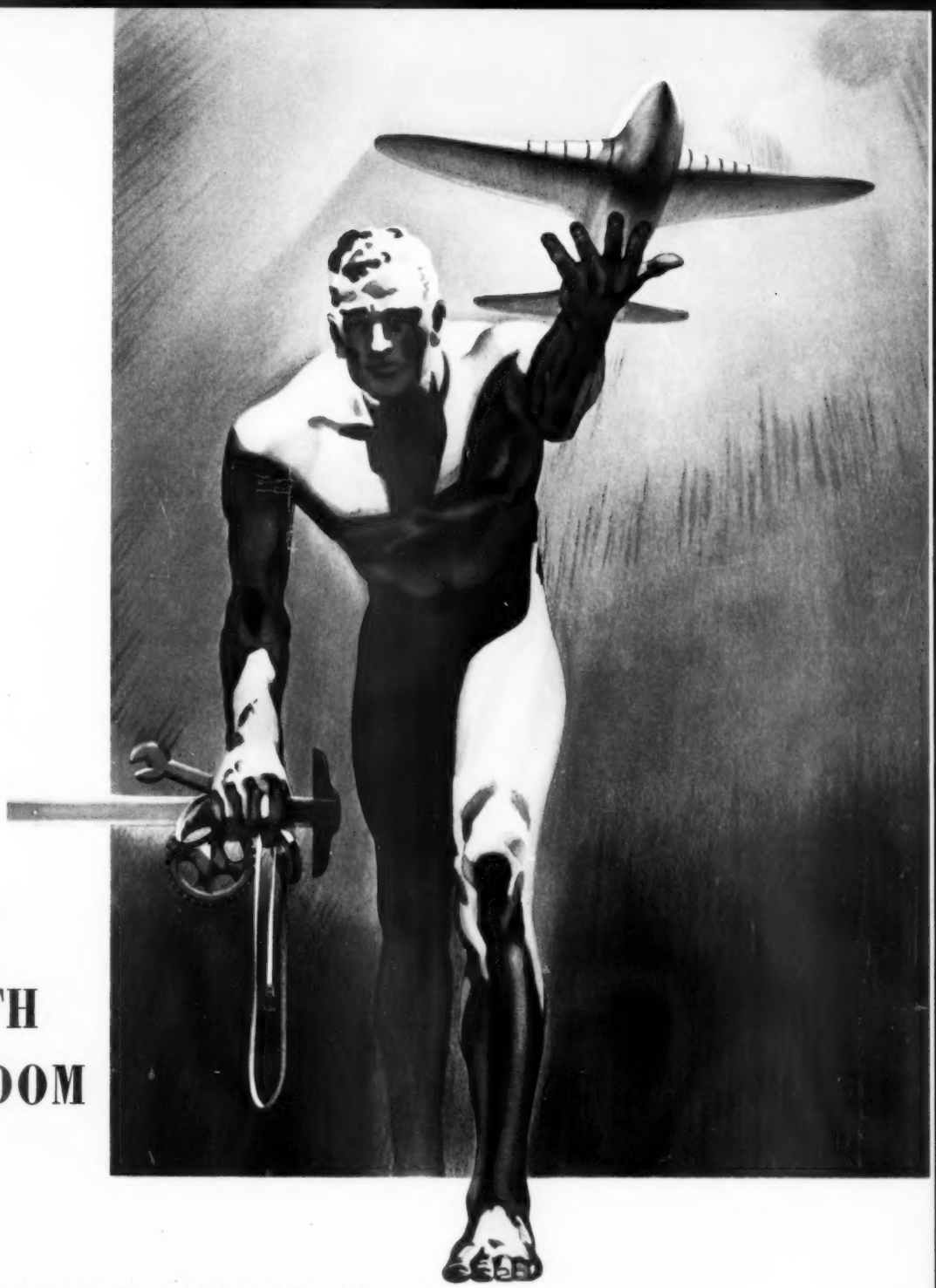
Fairchild "Cornells" of the Royal Canadian Air Force doing formation flying above the clouds.

HUNTER

Ready for a fight, this Navy airman is about to take his Grumman "Wildcat" up on a short patrol.

GUARDIAN

Medium-sized practice bombs are loaded aboard a North American "Mitchell" for a tryout bombing.



A FIFTH FREEDOM

To the four freedoms, will be added some day, a fifth freedom—*freedom of flight.* But it can't come till victory has assured the other four. Then . . . freedom to fly with safety, with economy, with comfort and convenience —will mean much to post-war peace and prosperity.

For post-war aircraft will measure trans-oceanic flights in hours, and can literally make all the world, good neighbors. Cities in near-by states will be less than an hour away, and the further development of the helicopter, will actually make *home-based* aircraft feasible and possible.

That's something to work for and plan for. But *right now* we've got something to fight for. We're glad that we, at McDonnell, can add our share to the gigantic contribution which America's aircraft industry is making to victory . . . and to the preservation of the four freedoms which are fundamental to democracy.

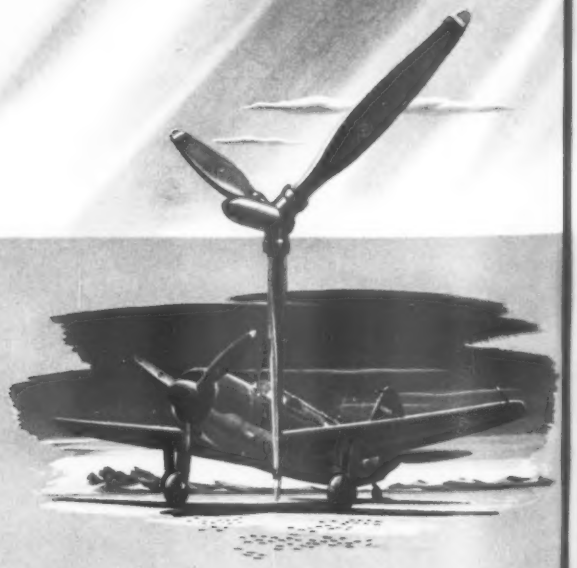
McDONNELL *Aircraft Corporation*

Manufacturers of PLANES · PARTS · PLASTICS ★ SAINT LOUIS - MEMPHIS ★

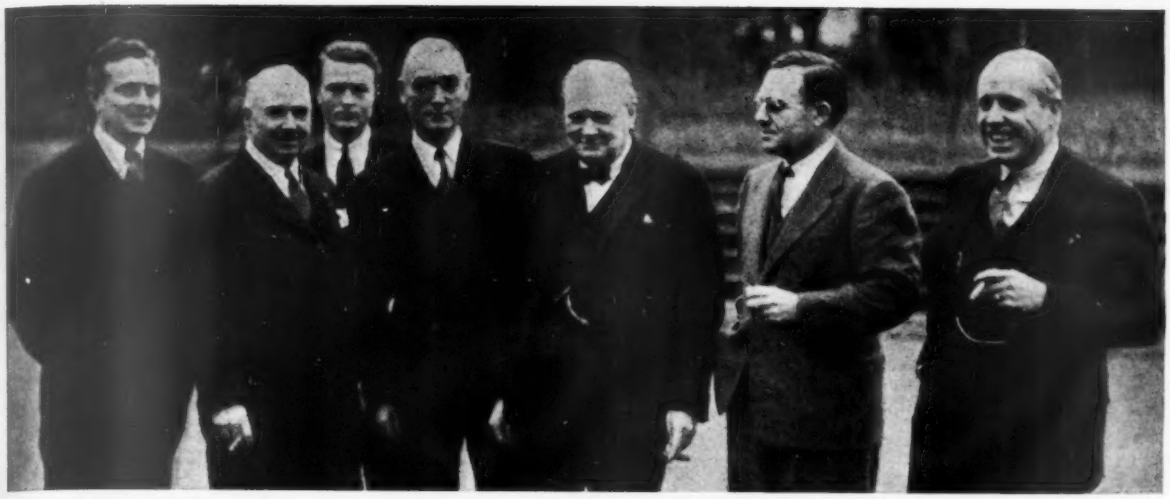
CURTISS A-25

New U.S. Army Dive Bomber makes its Debut!

THE powerful new Curtiss A-25, embodying the latest design features for dive-bombing tactics, is also equipped with the Curtiss Electric Propeller.



CURTISS ELECTRIC PROPELLERS



During the 1941 inspection trip to England, these congressmen were photographed with Prime Minister Churchill. From left to right are Congressmen Cole, Maas, Delegation Aide Munson, Congressman Hill, Churchill and Congressmen Gale and Baldwin.

WORLD PARTNERSHIP IN THE AIR

by WILLIAM S. HILL
Congressman from Colorado

Reciprocal airway agreements between nations may be a major point in the tremendous development of global aviation in post-war era.

THE development of the airplane has made isolationism as obsolete as the 1918 *Jenny*. After this global war, there will be some system of world union or international federation. It will be devised upon the basis of conditions as they shall then exist. These conditions are impossible to forecast. But aviation, as the influence which has erased the potency of national boundaries will be the major force at those conferences.

The principle of freedom of the air must be a basic general premise for the post-war pacts. Indeed, there are few nations which would desire to seal the air over their territory from all other peoples. But, just as surely, the so-called "right of innocent passage" cannot be construed to permit the possibility of aerial reconnaissance or photography over strategic areas. In addition to the usual domestic regulations there will have to be air lanes from which foreign planes shall not deviate and stated airports which they may utilize. The extent of their cargo and passenger carrying activity will have to be settled by reciprocal agreements between the sovereignties concerned.

Reciprocal agreements between governments are just glorified horse trades. Just as there can be no hard and fast rules laid down to regulate trading,—since all horses, traders, community customs and available financing differ—so we cannot deal with all nations, much less with all air bases, as in the same category. One nation may bring a great deal more to the conference than another can show. One base may be interesting only for geographical or logistic reasons, as at the Panama Canal; another may represent the hinge on a great trade route as at Natal in Brazil; while another may be a combination of these as in Trinidad Island. Bases may have one value to one nation and a quite different aspect to another. But the nations truly desirous of having world peace will frame agreements concerning normal use of the air above all the earth by civilian commercial airplanes.

All that it takes to make international agreements work is the will to *have* them work. I was impressed with this fact when I inspected the great Portello Airport out of Lisbon with a group of fellow congressmen. There planes of all nations were coming and going and there was no friction, even though they came from nations which were at war. There were British planes loading for England; German planes ready to fly to Switzerland; French planes leaving for Africa; Spanish planes, Portuguese, of course—and other nations. All recognized the territorial sovereignty of Portugal and observed the local regulations and customs restrictions. There the principle of freedom of the air was being exemplified in the midst of war. How very much simpler would be its administration among nations in time of peace.

We, and all of the United Nations, stand pledged for a victory in this global war and for world peace thereafter by mutual insistence of some sort. Just what form that will take we cannot now draft, but we are definitely in on this project and must take the lead in its fulfillment. And the snapper in the whip of enforcement, without which no law is effective, will be an international air police power.

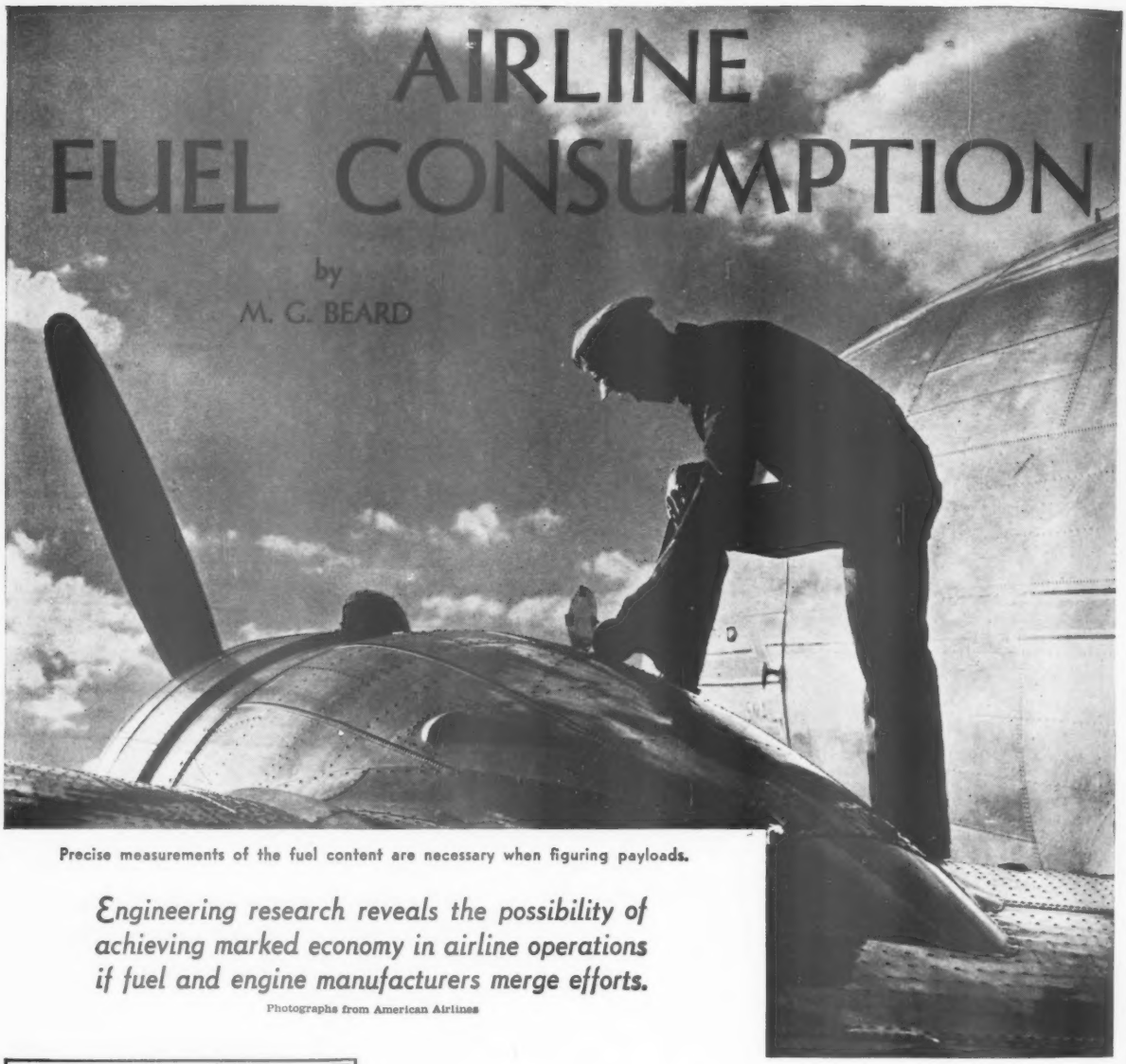
The peoples of a large part of the world are becoming aware of the power which is America. They see or they hear about the Boeing *Flying Fortresses*, the Consolidated *Liberators*, the North American *Mitchells*, the Martin *Marauders* which

(*Continued on page* 158)

AIRLINE FUEL CONSUMPTION

by

M. G. BEARD



Precise measurements of the fuel content are necessary when figuring payloads.

Engineering research reveals the possibility of achieving marked economy in airline operations if fuel and engine manufacturers merge efforts.

Photographs from American Airlines

Flying since his graduation from Kelly Field in 1918, "Dan" Beard has gained much aeronautical and engineering data in his positions as test pilot and airline captain. as chief engineering pilot for American Airlines, he compiled this report for the S.A.E. Journal. It is published with their approval.

SECURING accurate data on airline fuel consumption has been a difficult problem ever since airline transportation came into its own and took its place in the ranks of Big Business in the United States. Airplane development progressed so rapidly that the airlines hardly had operating procedures well established on one model before a new model came into operation. This succession has continued through the past 20 years, until the Douglas DC-3 and DST became the standard airline transport of the United States. Even though the DC-3 is similar in structure for all the airlines, there have been more than five different model engines installed in this basic ship for use in scheduled air transport service in this country. In addition, the DC-3 is being used both on long and short schedule operation so that over-all fuel consumptions must be studied in relation to the type of schedule as well as to the type of engines and carburetors being used.

When surveying the subject of fuel consumptions in airline operation, consideration must be given to all engine running which requires the consumption of gasoline. However, considering only operation of engines in the airplanes and neglecting fuel consumed in overhaul testing of engines will enable us:

1. To break down airline operation into its various phases related to consumption of fuel.
2. To give an idea of the average consumption of fuel for each operating phase.
3. To compare consumptions between the two major methods of mixture control now used on the airlines.
4. To show the possibilities of fuel savings by the airlines during the present emergency.
5. To compare basic types of fuel as to possible use in airline operation.

Engineer and recorder took temperature indicator readings during fuel consumption test flight.

In starting a breakdown of fuel consumption in airline operations, it might be well to first look at a scheduled operation flight plan as made out by the captain prior to the flight and also the corresponding flight log kept during the flight. Figure 1 shows the flight plan made by Captain Hulett for a trip from Nashville to New York. It is a non-stop flight between the two points as shown by the first two columns.

The symbols in the second column are for the radio range fixes along the route. The mileage between check points is in the third column. The magnetic course for each leg is in the fourth column. The horsepower to be used is in the sixth column. The temperatures anticipated for the altitude to be flown are in the seventh column and are given by the meteorologist on duty at the originating point of flight. The true airspeed in the eighth column is taken from the DC-3 cruising chart. The altitude to be flown is in the ninth column. Wind direction and velocity is in column ten. The time between fixes in the last column is calculated from the true airspeed in the eighth column, the heading in the fifth column, and the ground speed in column eleven.

At the bottom of the flight plan, the fuel requirements for the flight are made. It is noted that the captain figured 400 gallons were required for a flight of 4 hrs., 7 min., or an average of 97 gallons per hour. In this average consumption, he allowed a lump sum of 10 gallons for taxiing from the loading ramp to the end of the runway, for the run up of each engine prior to takeoff, and takeoff to 1,000 feet altitude. He also averaged the climbing rich consumption with the cruising lean consumption to make an average of 97 gallons.

This actually has a liberal allowance of three gallons per hour over the average block to block consumption of 93.5 gallons per hour, calculated from past performances of the whole fleet of DC-3s, when using 600 hp. for cruising. The weather map indicated a possibility that ceilings or visibility might go below limits before the trip arrived at La Guardia Airport, so Hartford was chosen as the closest safe alternate where the weather would be certain.

The captain allowed 75 gallons for alternate destination and 50 gallons for possible instrument approach at Hartford. Instrument approach includes the amount of fuel which might be burned while cruising around awaiting his turn to make the instrument approach.

In addition, the captain added 100 gallons reserve which include legal and company reserve, making a total of 625 gallons required on board at Nashville to make the flight.

The same check points appear on the flight log (Figure 2) as on the flight plan. Time over the fix is recorded in the fourth column, the time over the next check point is estimated ahead, taking into consideration the time made on the last leg and the anticipated wind direction for the next leg. The actual time over the

Figure 1. This is the flight plan of a trip between New York and Nashville.

FLIGHT PLAN

FROM	TO	MILEAGE	MAGNETIC COURSE	COMPASS HEADING (UNCORRECTED FOR DEVIATION)	HORSE POWER	TEMP.	TRUE AIRSPEED	ALT.	WIND DIRECTION & VEL.	GR'ND SPEED	EST. TIME OF LEG	EST. TIME TOTAL
NA	XM	61	98	94	600	30	150	9000	300 - 25	153	:20	
	ICK	102	94	91		30	150	9000	270 - 25	208	:29	
	JR	102	66	62		25	135	9000	270 - 25	206	:30	
	US	102	66	62		25	135	9000	270 - 25	206	:30	
	RO	45	73	70		20	135	9000	270 - 30	212	:13	
	GJ	113	65	61		20	135	9000	270 - 30	212	:32	
	FMS	67	66	62		20	135	9000	270 - 30	212	:19	
	WB	21	18	10		20	135	9000	270 - 30	192	:06	
	XBT	35	92	92		20	135	9000	270 - 20	200	:11	
	PG	92 - 50	92 - 50	92 29		25	135	7000	270 - 20	201	:26	
	XH	84	33	31		25	120	15000	270 - 15	197	:25	
	LG	14	94	92		30					:06	
												4:07

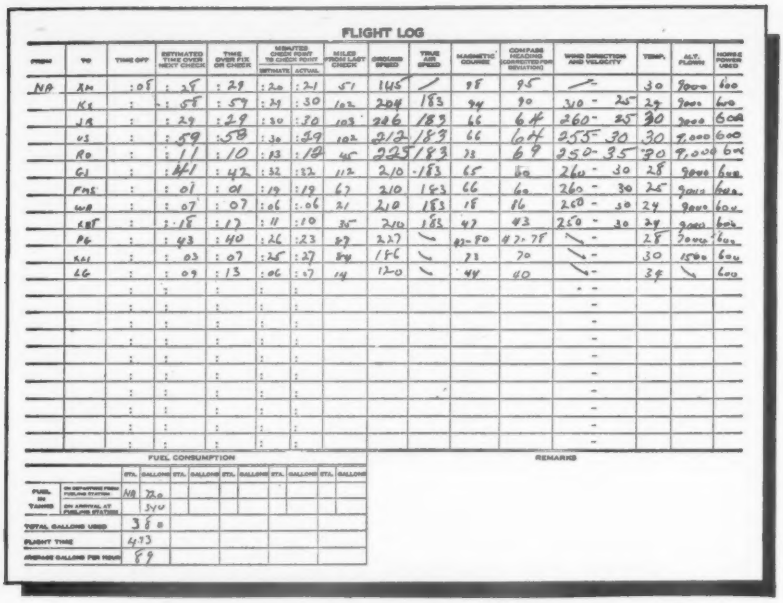
REFUELING POINTS	FROM	TO	FROM	TO	FROM	TO	FROM	TO	FROM	TO
	NA	NY								
REFUELING POINT TO REFUELING POINT										
DESTINATION TO ALTERNATE	400									
INSTRUMENT APPROACHES @ ATC.	75									
TOTAL GALLONS REQUIRED	50									
ALTERNATE AIRPORTS	625									
	HT									

STATE DESTINATION IN CASE OF TOTAL RADIO FAILURE WA-

CAPTAIN PB Hulett

FLIGHT SUP'T _____ METEOROLOGIST _____

THIS FORM TO BE MADE OUT IN TRIPLICATE



FLIGHT LOG

FROM	TO	TIME OFF	ESTIMATED TIME OVER NEXT CHECK	TIME OVER FIX OR CHECK	MINUTES CHECK POINT TO CHECK POINT		MILES FROM LAST CHECK	GROUND SPEED	TRUE AIR SPEED	MAGNETIC COURSE	COMPASS HEADING CORRECTED FOR DEVIATION	WIND DIRECTION AND VELOCITY	TEMP.	ALT. FLOWN	HORSE POWER USED
					ESTIMATE	ACTUAL									
NA	AM	:05	:25	:29	:20	:21	51	145	/	98	95	/	30	9000	600
	KE	:	:58	:29	:29	:30	102	204	183	94	90	310 - 25	29	9000	600
	JA	:	:29	:29	:30	:30	103	206	183	66	64	260 - 25	30	9000	600
	OS	:	:59	:58	:30	:29	102	212	183	66	64	255 - 30	30	9,000	600
	RO	:	:11	:10	:13	:12	45	225	183	78	69	250 - 35	30	9,000	600
	GI	:	:41	:42	:32	:32	112	210	183	65	60	260 - 30	28	9000	600
	PHI	:	:01	:01	:19	:19	67	210	183	66	60	260 - 30	25	9000	600
	WA	:	:07	:07	:06	:06	21	210	183	18	16	260 - 30	24	9000	600
	KEY	:	:15	:17	:11	:10	35	210	183	47	43	260 - 30	24	9000	600
	PE	:	:43	:40	:26	:23	87	227	/	82-80	47-75	/ -	28	9000	600
	NAS	:	:03	:07	:25	:27	84	156	/	73	70	/ -	30	1500	600
	LG	:	:09	:13	:06	:07	19	120	/	44	40	/ -	39	/	600
		:	:	:	:	:						-			
		:	:	:	:	:						-			
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FUEL CONSUMPTION

		STA.	GALLONS	STA.	GALLONS	STA.	GALLONS	STA.	GALLONS	STA.	GALLONS
FUEL IN TANKS	ON DEPARTURE FROM FUELING STATION	NA	720								
	ON ARRIVAL AT FUELING STATION		340								
TOTAL GALLONS USED			380								
FLIGHT TIME			4.23								
GALLONS PER HOUR			89								

REMARKS

Figure 2. The flight log is a stage by stage report of the airliner's trip.

fix is recorded in the fifth column and in the seventh column the actual time from check point to check point is listed. The rest of the log is merely a recording of flight as to ground speed, true airspeed, magnetic course, compass headings, wind direction and velocity, as calculated from ground speed and magnetic course, air temperature, altitudes and horsepower used. A running check is kept on the fuel consumption so that at any point along the route a report of consumptions and fuel on board can be made if called for.

At the bottom of the flight log is a bracket for fuel consumption. If the passenger and cargo load had been heavy and the reserve fuel was close to the total estimated necessary out of Nashville, a landing might have been made at Washington for fuel, especially if the weather from Washington to New York became worse than the meteorologist anticipated prior to departure of the flight from Nashville. With this particular flight, however, there was no question concerning fuel and consequently the pilot recorded total fuel on board before departure from Nashville and upon arrival at New York. It will be noted that while only 625 gallons of fuel were required for the flight, the passenger and cargo load permitted more and the captain and flight superintendent elected to put it on; therefore, 720 gallons were put on board at Nashville. Upon arrival at New York, there were 340 gallons remaining in the plane, making 380 gallons used. The flight lasted for 4 hrs., 13 min., making the average hourly consumption 89 gallons per hour.

This 89 gallons per hour is a round figure and subject to several minor errors which may affect considerably the average figure required on the flight log. There are two methods of measuring the fuel in the tanks: by reading the meter on the gasoline truck or at the fuel pits while the plane is fueled for the flight. To check this reading, a stick measurement is always made on the quantity in the gas tank after the fueling has been completed. In addition, the plane's fuel tank gauge readings are checked. These three readings may agree, depending upon the accuracy of the fuel truck or pit meters, the accuracy of the fuel gauge in the plane, the accuracy with which the stick measurements were made to check this figure, the levelness of the plane as it stands on the ramp and the care with which the attendant places the stick on the bottom of the tank for measurement.

Securing an accurate estimate of the exact quantity of fuel in a plane, at any instant, whether in flight or on the ground, is one of the most difficult problems related to the study of fuel consumption. All types of fuel gauges thus far developed and now in use in airline operation are subject to errors which, at times, may be as great as 10 per cent of the quantity being measured. Added to gauge inaccuracies is the problem of estimating the amount of residual fuel remaining in the bottom of the DC-3 fuel tank which is, in general, flat but filled with pockets and ridges and crossed by baffles. These irregularities trap between three and 10 gallons of fuel, depending upon the relative smoothness of the tank bottom and the altitude at which the plane is flying when the tank supposedly runs dry. Future fuel tanks should eliminate one large source of error and steady progress in the development of accurate fuel quantity gauges will greatly assist in obtaining more accurate and reliable data on fuel consumptions in flight; in addition, the trend is now towards transport planes with tricycle landing gear which allows the plane to rest more nearly level on the ground. This feature will eliminate one of the large discrepancies heretofore encountered in the conventional landing gear between tank gauge readings on the ground and in flight.

Average fuel consumptions, chargeable against any given airplane, include all ground and air operation. This figure could be divided by the total flying time of the ship to obtain an over-all fuel consumption per flying hour or it could be charged as per day, per month, or per year. This figure is sometimes used in practice for accounting purposes, but the engineer is inclined to regard the over-all consumption as too inclusive and to break it down into its component parts, setting aside the less important components and concentrating on the operations which will produce the most returns from careful investigation, experimental work, and continued watchfulness. Block to block, or ramp to ramp fuel consumptions are very frequently used, especially by the operations department of the airline, as this figure is readily usable directly in calculating fuel requirements for scheduled operation. The block to block figure is also too inclusive for the engineer as it still contains several miscellaneous operations relatively unimportant to the problem of fuel economy. The phases of engine operation in relation to fuel consumption with which the engineer is most vitally interested, start with the take-off and end when the pilot throttles back and prepares for his initial approach into the field.

Although very little can be gained in economy by a detailed study of the ground operating phases, such a study was made as a matter of general interest and for use in future computations of over-all fuel consumptions in airline operation. The various phases of engine operation were broken down as follows:

A) STARTING: The fuel consumed in starting an 1,830 cubic inch engine is almost negligible. The average of a large number of perfect starts is about .42 lb. per start. Allowing for additional winter priming, it should not exceed .5 lb. start as a yearly average. The consumption for larger engines is probably proportional to the displacement of the engine.

B) ENGINE WARM-UP, FUNCTIONAL CHECK AND PRE-FLIGHT CHECK: This phase includes the engine cylinder and oil warm-up period after starting the engine, during which the line inspector checks the functioning of the engine and airplane accessories and all instruments; the run-up of the engines to check ignition (usually at some prescribed power considerably lower than take-off power); and the run-up to check the engines, accessories and instruments at the terminal points after the flight prior to servicing the plane for the next scheduled run. The time and engine running required for this check averages about 15 minutes for winter and summer and the fuel consumed is about 50 lbs. for checking both engines.

C) TAXIING: This operation includes taxiing of planes by line maintenance, taxiing of planes to the loading ramp, and all taxiing to and from the terminal in schedule operation. The amount of taxiing varies greatly with the size of the field. Studies made at Chicago in 1938, allowed an average of two minutes

(*Continued on page* 120)

GUINEA PIGS GROW WINGS

Lieutenants Snyder (left) and Tiegs, members of first civilian class, check Vultee BT-13 in which they now teach cadets.

The Enid, Okla., traffic pattern (sketched on blackboard) is explained to students by Lieutenant Spiers.

Trio of former civilian pilots, now Army instructors, watch as Captain Duganne checks cross-country course.

by Lieut. ALBERT W. SPIERS

How the Army taught civilian pilots to become flight instructors for the AAF.

Photographs from U. S. Army

DAYS of late spring rain had made a chocolate quagmire of the Enid, Okla., Army basic flying school so that I, a newcomer, did not feel completely out of place. My civilian clothes and strictly non-military manner might be awkward and obvious—but my shoes were exactly like those of the hundreds of trim, uniformed men hurrying about. They were muddy!

The usually crisp, dry Oklahoma air was sultry and smothering, hot and uncomfortable. More rain was coming.

Following tall Pvt. Don Mason, I slithered through red goo into Barracks Nine, a gaunt, bare, two-story building quartering 40 men, three to a room. Mason stopped at Room 5.

"Your room, sir," he said, waving a grand arm in mock solemnity. He must have noticed the slack in my jaw and the pain in my eyes, for he added quickly, "Not exactly the Ritz-Carlton—but you'll get used to it in a few days."

I wondered. That room, with its three slab-looking cots, tiny desks, folding metal chairs, unfinished walls, unpainted windows and cold, bare floors was the last fraction of stick before a full stall. My spirits whooshed like an air-starved fighter. Confusion, bewilderment, the pesky mud, muggy air and now this prison-like room crystallized in a single, sickening thought:

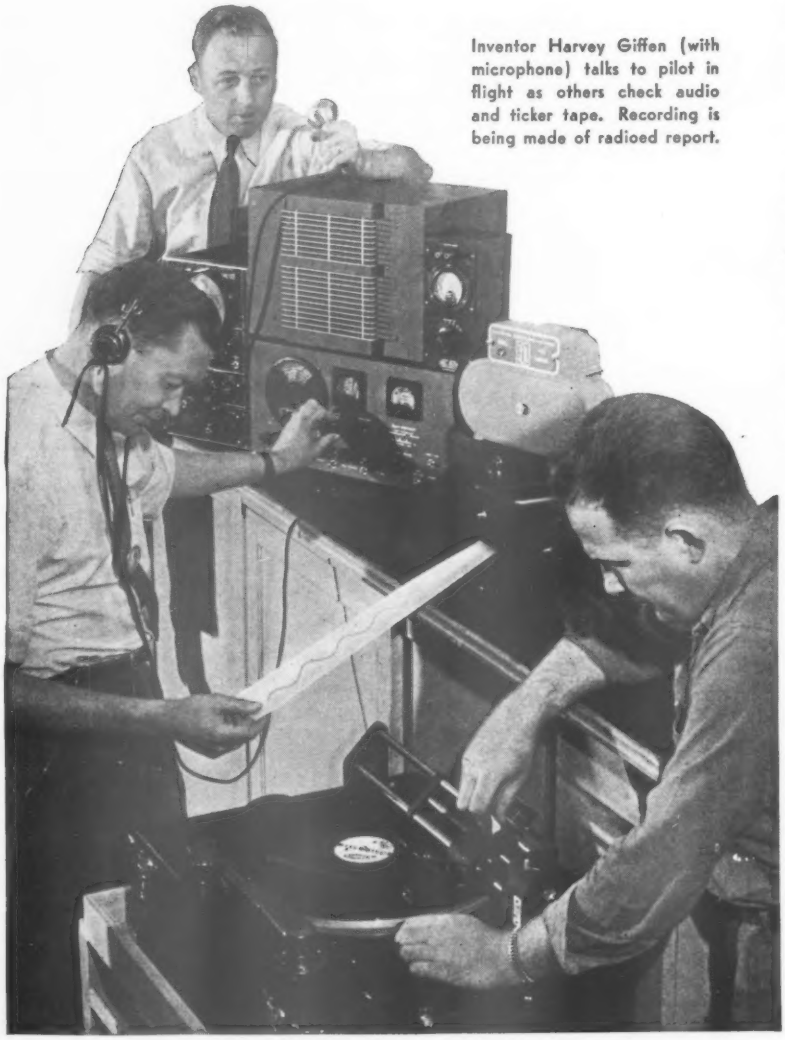
"I've blundered into a mess. This isn't (*Continued on page* 140)

FLIGHT TEST RECORDER

by LYNN C. THOMAS

Photographs from Vultee

Radio signals make possible an irrefutable record of how a plane is standing the stress of a test flight.



Inventor Harvey Giffen (with microphone) talks to pilot in flight as others check audio and ticker tape. Recording is being made of radioed report.

OFF the smooth runways of Vultee Field a new warplane takes to the air to undergo its first test flight under conditions far removed from the good old days when a test pilot took a new ship up and did his best to tear the wings off. If he brought it back in one piece, the plane was put in production. It was okay.

But today the test pilot is no longer the sole judge of the flight characteristics of new Vultee planes, for he carries a strange companion in the ship with him —a crawling mass of wires, metal and tubes that can tell to a gnat's eyelash the exact performance of the craft as well as foretell possible structural failures.

Instead of everything depending upon the flyer's personal reaction to the plane and all the information contained in his penciled notes jotted down during the course of the flight, a series of audio radio signals are flashed to earth at split-second intervals by a unique flight test recorder that experts say will be of as much value to aviation as the invention of the X-ray and fluoroscope is to medicine and surgery.

Besides the test pilot, mechanics and engineers who ordinarily are on the job when testing new warplanes at the Vultee plant in Downey, Calif., a small group of radio engineers are on hand to record the entire flight test procedure and to keep a constant check on the plane while it is in the air.

With the use of the new radio device—affectionately known to the aircraft engineers as their "flight test stenographer" the production of the modern warplane will step far ahead of schedule. For this instrument will be released to all aircraft plants across the nation that are bringing out new model fight craft. Long months of flight testing and laboratory work that always go into a new plane before it can be put into mass production will be shortened considerably.

Most of the credit for the invention of the flight test recorder must go to Harvey D. Giffen, Vultee radio engineer and former Hollywood sound technician for the R.K.O. motion picture studios. Giffen has a good background for his work, for he has had years of experience in experimental radio. In Hollywood, he worked on many of the major films of the past decade, pictures that have gone down in history as among the finest ever produced, both in dramatic presentation and the finely developed technical direc-

The sending apparatus (above) being installed in a Vultee "Vengeance" reports data during test flight (upper left).

tion and sound processing. For nearly a year and a half he toiled over the flight recorder, finally bringing it to the point where it could be used in actual flight testing.

High speed recordings are made by means of special pickups which are designed to respond to various stimuli from pressures, temperatures, strains, atmospheric conditions, fuel flow, vibrations, records of throttle, flap, control positions, loads and movement. It is possible to scan those pickups at a maximum rate of 100 readings per second and to automatically transmit them by radio to the ground where permanent recordings and analyses are made.

The advantages of using radio transmission is obvious, for in testing new type airplanes it is not unusual to lose a ship in a crash and too often the cause of the failure cannot be determined. With flight test data transmitted to the ground by radio, a permanent record of what transpired is available and in all probability would prevent a duplication of the accident. In addition, space requirements in many airplanes prevent the use of recorders of sufficient capacity to handle the required number of pickups. The most important advantage of radio recording in flight testing is that instruments can be charted on the ground and observed by a number of engineers so that the pilot can be advised via two-way radio of existing conditions during the flight, thereby saving a possible crack-up, the loss of a life and a valuable airplane.

The radio equipment carried in the plane consists of a standard transmitter, the pickups or wire "feelers" that go out to some 70 different parts of the ship and are so constructed that all variable factors involved are automatically cancelled except the factor to be measured. Each pickup with its leads forms two arms of an A.C. bridge. The temperature pickups are of the resistance type constructed to follow rapid changes in the medium being tested. They consist of a copper tube, a thermal insulator of special cement, the resistance wire winding, and a thin copper plating over the winding. The use of all copper parts in the construction prevents the introduction of errors due to mechanical strains from expansion and contraction of the unit.

Also carried in the plane is a scanning switch weighing about 12 pounds and occupying approximately ¾ cubic feet of space and the converter unit which weighs 15 pounds and occupies about one cubic foot in the airplane. With these instruments the pilot can scan the various pickups and convert their readings into corresponding audio frequency oscillations, which are then fed into the microphone in-put of the airplane transmitter. The ground equipment, in turn, receives those signals and records them.

Checks such as these may be kept on the craft at any distance up to 100 miles and static instrument readings do not affect the analysis unless a continuous static totaling more than 30 per cent of the signal is present and then limiter circuits similar to those used in frequency modulation receivers remove the static from the signal.

Signals transmitted from the airplane are picked up by the ground engineers and recorded, a disc recorder being used in most cases to make a master record as a safety measure in case of failure of any of the other instantaneous recorders or of the decoding apparatus. In addition, the signals can be decoded electronically and recorded on paper charts, the chart width and accuracy depending on speed of the scanning switch in the plane being tested.

In power plant studies, where readings are taken at the rate of one instrument per second, direct paper charts of six inch width can be made as the signals come in, by using a standard commercial graphic pen and paper recorder.

Strain observations are taken by measuring a standard type wire-wound strain gauge and an unstressed dummy gauge mounted nearby with the leads forming two arms of the bridge to cancel out the effects of temperature. Readings of such effects as load distributions during maneuvers of the plane are taken at the rate of 100 per second, recorded on both the disc and film and then automatically decoded by a specially developed analyzer.

This instrument consists of a projection of each image of each instrument signal through an optical scanning system which determines the frequency of the recorded signal and then plots the related amplitude on a pen and ink chart. In addition to converting the frequencies to their corresponding amplitudes, the analyzer moves the correct chart for each pickup into the proper recording position when the film image of that pickup is moved into the decoding system. The changes in the stimulus for each pickup are thereby plotted on a separate chart, with approximately three seconds required per indication to accomplish this automatic decoding and plotting.

In present operations a change of 5,000 c.p.s. (cycles per second) for the total range of each instrument has been chosen as full scale. Each pickup is therefore designed to cause a 5,000 c.p.s. change in the converter unit when the pickup is subjected to the maximum change in stimulus which it is required to measure. The graphic recorders, used as frequency meters, respond full scale to 5,000 c.p.s. change. Therefore, a strain gauge having a range of 50,000 p.s.i. (pounds per square inch) and subjected to a 10,000 p.s.i. load will produce a change of 1,000 c.p.s. in the converter unit and will be plotted at one-fifth full deflection on its chart. An air speed pickup designed for a 500 m.p.h. range will, when the ship is flying at 100 m.p.h., cause a frequency change of 1,000 c.p.s. in the converter and will be charted at ⅕ full deflection on a similar chart calibrated at 500 m.p.h. full range.

Extreme flexibility is an outstanding feature of the radio recorder. All leads from the pickups are brought to a terminal board at the scanning switch where any desired continuity can be set up. An example of this is in dive and pullout studies, where acceleration plus the added effects of air bumps is the important factor.

The scanning switch can be set up to read acceleration 50 times in a second in addition to 50 other pickups in the same second or the pilot may be provided with a selector switch with which he can select

(*Continued on page* 169)

SOME SOLDIERS DON'T SHOOT

by KURT RAND

Among all the trades taught by the Army, perhaps the most highly skilled is that of the instrument repairman who uses the techniques and tools of fine watchmakers.

Instructor shows a soldier-student how to assemble turn and bank indicator.

THIS is a watchmaker's war, too.

And not just because it's total war, with everybody—men, women and children, military or civilian—in it to the finish.

It's a watchmaker's war because it's predominantly an aerial war, and modern air warfare is precision instrument warfare.

The pilot of a *Thunderbolt* or a *Flying Fortress* is, in courage and daring and hair-trigger decision, the spiritual descendant of the World War ace who flew by the seat of his pants. But he's as far removed from that kind of flying as his plane is from the last war's Spad, or Fokker, or Jenny.

That is why, out in Chicago, there is being conducted one of the most unusual training operations to result from the present war. There, without much fanfare or public notice, hundreds of men of the Army Air Forces are being taught one of the most delicate and precise jobs that any enlisted man will ever be called upon to do.

It is aircraft work, but there's never an airplane in sight. These men are mechanics, but there are no large lathes, drill presses or milling machines for their work. It's a machine shop, but the ear-splitting din of the machine shop is missing.

Instead, soldiers are found at spotlessly clean benches, with jewelers' magnifying glasses at their eyes, poring over tiny little mechanisms that look a lot like the inside of an alarm clock. They are working on aircraft instruments—compasses, altimeters, engine gauges and all of the 50 or more types of instruments upon which the Air Forces pilot must depend for the fulfillment of his mission.

At the Chicago School of Aircraft Instruments and the Aeronautical Institute men are being taught to overhaul, repair and calibrate such instruments so that later, behind the lines of some overseas battlefront, they will be able to keep in operation a plane that otherwise might

An advanced student is being shown how to assemble the gyro artificial horizon.

be grounded. And it may well be that their efforts will mean the difference between life and death for many a pilot and his crew whose lives are at the mercy of their instruments.

Unlike the World War ace who had to depend, by and large, on his own educated guessing and prayerful conjecture for an approximation of his speed, rate of climb, altitude and engine performance, the modern pilot has on the panel of his plane dozens of the most complicated instruments devised by man, and every one has an important purpose.

There are instruments that tell the pilot whether or not his engines are functioning correctly—oil gauges, fuel gauges, manifold pressure gauges, fuel mixture analyzers and many others.

There are devices which indicate whether or not the different parts of the plane are doing the work they are meant to do—wheel position indicators, de-icer pressure gauges and the like. Still other instruments tell the pilot where and how he is flying—compasses, air speed indicators, accelerometers, rate-of-climb indicators and so on.

Then, there are those ingenious mechanisms vital to blind flying, the artificial horizons, the sensitive altimeters, directional gyros, even automatic pilots—instruments upon which the lives of the pilot and crew depend constantly.

Instruments like these are delicate mechanisms, fine as a pharmacist's balances. A sharp and unusual maneuver in the air, a bad landing, or any other shock will put many of them out of commission. And unless there is someone at hand to overhaul, repair and adjust them, the plane is out of service.

The repair of such instruments as these is not a job for an ordinary mechanic; it's no monkey wrench and strong arm proposition. It takes a man with peculiar talents, one who has had a very definite specialized training, something of a combination of watchmaker and toolmaker.

At the Chicago School of Aircraft Instruments a new class of airmen enters each Monday morning to remain for 12 weeks. A similar class graduates each Saturday night. In addition, several hundred civilians also are undergoing training at the insistence of the Army Air Forces. Many of these men will wind up eventually as enlisted men in the Air Forces. Others will fill civil service appointments at AAF maintenance depots.

The AAF men attend classes and do practice work eight hours a day, six days a week. During the 12-weeks course each student works on aircraft instruments valued at approximately $10,000, and uses special tools and test equipment worth another $15,000.

The men selected to attend these schools are chosen for their ability and aptitude, because the instrument me-

(*Continued on page* 167)

During first two weeks of student's training, he learns to operate a small jeweler's lathe.

Photographs from Wright and McKinney, Inc.

"Pink Lady"

by Joseph Morton

THE airport dispatcher "somewhere in Africa" had her down as a B-24 bomber but the boys called her the *Pink Lady*.

I couldn't make sure why they chose such a name, although it might have been because she was painted pink for desert fighting, had a voluptuous red-headed girl in bathing trunks on one side of the fuselage and a brunette in even fewer clothes on the other.

There certainly was nothing else ladylike about her unless ladies, these days, are being turned out with four supercharged motors, wings more than 50 feet long, enough machine guns to slaughter a regiment and bombs so big they could sink a battleship.

She was a gal looking for a fight, on her way to the combat zone, when I stepped up to Lieut. Jim Harden of Oklahoma City, the pilot, and told him I was going his way.

"Sure, you can come along," he said. "We're short a crew member, anyway."

As he spoke he kept an anxious eye on eeny, meeny, miny and moe. They were perfectly splendid motors, he said, but eeny and meeny had given him a little trouble the previous day and he wanted to be sure they were feeling well before taking off again.

First eeny, then meeny, then miny and finally moe warmed up for his critical ear until all were synchronized in a roaring crescendo. The lieutenant listened a minute, then made the "okay" sign with his thumb and forefinger.

"Let 'er rip," he shouted.

I climbed up through the belly and on to the flight deck where most of the crew was sitting to concentrate weight in the nose for the takeoff. We waited, poised, while another plane got out of the way, then streaked down the runway and into the air with plenty of room to spare. One sharp bank and we were on our way across Africa.

"I'm going to pull her up to 10,000 and then let George take her over," Lieutenant Harden hollered back.

I hadn't met "George" but the other boys took care of the introduction. He was the little black box full of instruments on the dashboard in front of the pilot, they said—also known as the automatic pilot.

"Don't know what we'd do without him," Jim chuckled.

A little later I saw what he meant. The lieutenant had his brief case on his lap and was busy making out his payroll. "George" was flying the plane.

One by one the boys filed up to get paid.

"We do this every Tuesday," Jim said. "Tonight there'll probably be a crap game."

This job over, he handed me a newspaper and dug into a compartment for a mystery novel for himself. The co-pilot,

(*Continued on page* 162)

REPORT FROM WASHINGTON

By special arrangement, this monthly feature appears simultaneously in FLYING and "The Aeroplane" London

THE Committee on Interstate and Foreign Commerce of the House of Representatives recently favorably reported a bill (H.R. 1012) which squarely faces and provides an excellent means of solving one of the most difficult problems facing civilian aviation in this country. It directs the administrator of civil aeronautics to prepare a program for the regulation of the height of structures in the vicinity of airports where the safety of aerial navigation might be impaired and, through co-operation with local administrative authorities, endeavor to establish uniform zoning regulations throughout the entire country. Where necessary in the national interest, the administrator is given authority to prescribe areas in the vicinity of airports and to promulgate zoning regulations, subject to judicial review and the payment of compensation where private equities might be impaired.

Edgar S. Gorrell*

The necessity for action of this kind has been well-known to the industry itself for a good many years. Congress took cognizance of the growing problem as long ago as 1934, when it amended the Air Commerce Act of 1926, to require the maintenance of signals on certain types of structures that they might be made visible to pilots during night flights.

As great as has been the need for uniformity of zoning regulations to eliminate unnecessary safety hazards in the past, the need for the effective operation of such regulations continues to grow immeasurably. In the final analysis it is the municipal governments throughout the nation that will have a vital part to play in an adequate solution of this problem, even though the interstate character of commercial aviation and the vital role it is playing in national defense requires Federal concern and action.

Perhaps no other industry has ever concentrated so much of its engineering skill on the problem of safety in transportation as has the civil aviation industry of this country. From the very beginning of its existence the best brains in its personnel have given their attention to the problem. The industry can well be proud of the results attained. The fruit of its efforts is best measured, perhaps, in the fact that insurance companies now write day to day insurance on air travelers at rates as low or lower than that prevailing for other modes of travel. Insofar as the air lines themselves are concerned, they will continuously devote their best efforts to this question in order to continue that assurance of safety to its patrons.

The question of airport zoning regulations, however, is a matter beyond their control, and today the greatest hazards to air travel are almost entirely due to the lack of uniform regulations throughout the entire country. It is imperative that the present conditions be improved at the earliest possible date. The plans for the future of civil aviation require immediate action.

There can be no doubt in the minds of far-seeing men that with the declaration of peace, commercial aviation will progress at a far more rapid rate than its phenomenal growth prior to the war. The constantly increasing demand for the transport of all first class mail (and probably all mail), by air when it will save time in delivery to its destination, presages action by Congress which will undoubtedly make this a fact in the not unreasonable future. Paralleling this will be the tremendously increased utilization of air transport facilities for the rapid transportation of all manner of commodities by express to insure speedy delivery. At the same time, the technological advances already made under the stress of war emergency foreshadows huge cargo planes as quickly as they can be built following the war.

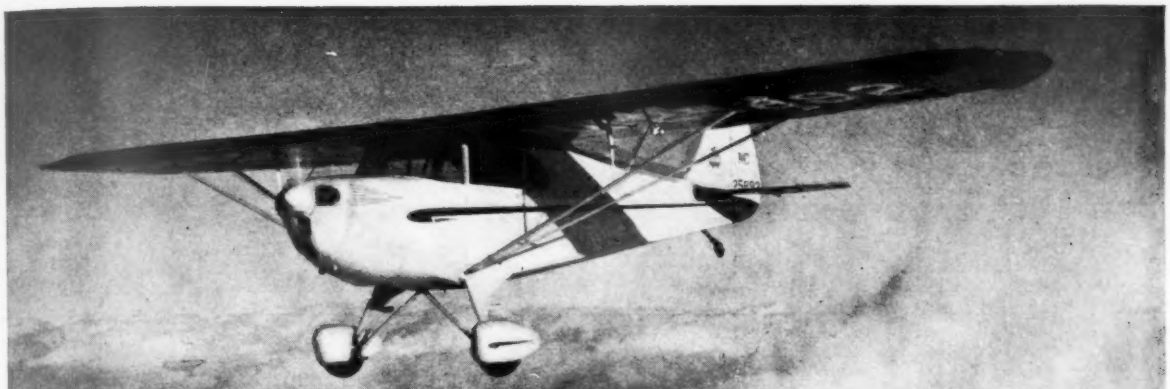
All of these facts point surely to the construction of numerous additional airports throughout the nation, with all of the attendant facilities required by aeronautics. Municipalities, states and the Federal Government, should unite in their co-operative effort to provide uniform zoning regulations that will prevent a heterogeneous and conflicting group of regulations producing confusion.

In fact, the Civil Aeronautics Authority has long since been conscious of the need for such zoning regulations, and it has been fully aware of the rights of local governments where the local airports are situated. Because of its technical knowledge of all of the aviation problems involved, it has been in a most advantageous position to draft such uniform regulations, and it has done so. It has no authority at the present time to bring these regulations into being, but it seeks the co-operation of local and state officials that it might place at their disposal its technical knowledge and the model ordinance which it has drafted.

From the practical point of view, this whole problem is far bigger than it might at first appear. Isolated local or-

(*Continued on page* 165)

* President, Air Transport Association of America.



DEAD RECKONING NAVIGATION

by E. L. COLLINS

Commercial and private pilots may benefit from this simple explanation of dead reckoning navigation as described by a veteran of many long distance flights.

THE inherent advantage of the airplane for transportation is that it can cross land or sea, swamp or desert, mountains or plains with equal ease. This freedom of movement away from fixed markers or routes also makes the airplane one of the easiest vehicles in which to get lost. Therefore, cross-country flights require some form of navigation and we should realize that a flight of this nature should be carefully prepared for in advance in order to carry it out safely and efficiently.

Radio navigation is the greatest aid to flyers in helping them to find their way, but it is omitted from this discussion because the flight may be over the water where radio ranges do not exist, or to some foreign country where radio aids are not so numerous as they are here. There also is the remote possibility that at some time we may have to turn off part of our system of radio range stations due to the military situation.

Be that as it may, we agree that a well planned "system" of navigation is very useful, and will help prevent mistakes which might otherwise occur because of the confusion which inevitably hampers the efforts of the average pilot in the air. Many manuals on navigation explain the subject in different degrees of detail, but this mass of information must be given a "screening" in order to get the essentials that we actually need and can use with the facilities at hand.

The triangle of velocities is a familiar figure to most pilots. To actually make use of it in the air is more difficult than to understand it in a classroom. As a rule any computation based on the triangle of velocities will have to be made in the air to be at all accurate. The reasons for this first complication of the "art" are apparent if we look at the triangle (Figure 1) and analyze it. The side (a), the length of which represents the airspeed, depends upon the loading, altitude, temperature and power setting, any one of which may vary. The side (b), which represents the track or actual path over the earth's surface, depends upon the variable (a) and the extremely variable side (c), which represents the wind force and direction. In a nutshell, all you have to do is solve a triangle with three sides unknown. You may think that the weather report will give you side (c), but this report is often too old by the time the flight is made to be of any value. A word of warning—if the instruments are not accurate or the pilot does not fly an accurate compass heading and a constant airspeed the whole problem is thrown off.

Graduate of Pensacola and rated to fly both single and multi-engined airplanes, E. L. Collins has built up long hours of cross-country flying in Navy PBY boats and as a pilot for the RAF Ferry Command. He is now employed by the Curtiss-Wright Corporation.

NAVIGATION LOG

Columbus—Cinn.	ETA	TIMES: Depart.	TIMES: Elapsed	TIMES: Distance	SPEED & ALT.: G/S	SPEED & ALT.: Cal. A.S.	SPEED & ALT.: Alt.	SPEED & ALT.: Temp.	SPEED & ALT.: T.A.S.	Track or True Co.	Drift ↘ +L	True	HEADINGS: Var. +W ↘	HEADINGS: Mag. (For)	HEADINGS: Dev.	HEADINGS: Comp. (Steer)	WIND: Dir.	WIND: Vel.	FUEL: GPH	FUEL: On Hand
Take Off	1000												240		242					60
Col.—Dep.	1004	8	13						233		233	2°W	235	2°W	237			15		
Dep.—A/C	1012	12	21	105	106	4000	18	116	242	9°R	233	2°W	235	2°W	237	18°	20	10		
A/C—S/C	1024	8–	13	100	106	4000	18	116	221	6°R	215	2°W	217	2°W	219	18°	20			
S/C—Cinn.	1032	31	56	103	106	4000	18	116	233	8°R	225	2°W	227	2°W	229	18°	20			
Total		59	103																	
Cinn.—A/C	1059																			
A/C—S/C																				
S/C—																				
Total																				

Figure 2. This log, accurately kept by the cross-country flyer, will give the necessary navigation data.

In order to handle all the figures and computations involved, even though they are relatively simple, the navigation log which I use is typed on a 5 by 8-inch card (Figure 2), which I'll explain by describing the use of each column. The columns are grouped under headings which are labeled "Times," "Speed & Altitude," "Headings" and "Wind." This arrangement makes a column easier to find. A quantity of the cards can be made up with certain items printed or typed on all of them. Items that are put in prior to a particular flight are shown in ink; while those entered during flight are in pencil. The first column is estimated time of arrival and would ordinarily be filled in after the ground speed has been determined and the elapsed time for the trip computed. The next column under "Times" is depart. Only departure time is considered because the use of both departure and arrival times requires two columns and is much more confusing. This system of recording time is almost foolproof. The third column, the elapsed time, is next and in it is recorded the elapsed time between two check points. The next column is the distance covered or to be covered. The first column under the speed & altitude group is the ground speed (G/S). This value is determined by combining the elapsed time and the distance, which appear in the two preceding columns.

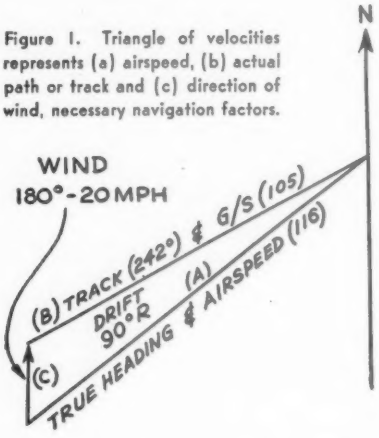


Figure 1. Triangle of velocities represents (a) airspeed, (b) actual path or track and (c) direction of wind, necessary navigation factors.

In order to arrive at the true airspeed (T.A.S.) one has to correct the indicated air speed (I.A.S.) (not shown on the card), for variations in temperature and altitude and for the installation error of the airspeed meter. The column labeled Cal.A.S. (calibrated airspeed), is used to record the airspeed after it has been corrected for the installation error. The next column shows the temperature and altitude and, with the aid of a computer, one can determine the true airspeed which is recorded in the last column of the group under speed and altitude.

The next column, labeled track or true course, serves a double purpose and simplifies the somewhat baffling problem of keeping the various courses, headings, tracks, etc., straight. As was mentioned before, the track is the actual path of the airplane over the surface of the earth. The true course is the path that it is desired to follow. If the navigation is perfect, the two are one and the same. The navigation does not have to be perfect, however, in order to record them in one column. The difference lies in whether the entry is made before flight or during flight. The next column is drift, and it is labeled right or left as the case may be at the time of an entry in the column. Notice that the true heading column and the track column are separated by the drift column, and that in figuring from track to true heading left drift is *added*, shown in triangle of velocities (Figure 1).

Now for the "headings," which are another source of error but which are very important and will require some thought, study and practice before their use is found easy. Their sequence can be remembered by the letters CDMVT which can stand for "Can Dead Men Vote Twice?", "Can Ducks Make Vertical Turns?", or "Compass, Deviation, Magnetic, Variation, True." A rule which will help one to remember when to add or subtract Variation and Deviation is "Add Variation West." This applies when going from true to compass which from right to left through CDMVT. When using CDMVT in its natural order, "Add Easterly When Correcting." This rule would be applied if one desires to convert a compass heading to the true heading. Notice an arrow in the variation column which will indicate when to add and when to subtract. The magnetic heading is simply a stage in the transition from true to compass and is of no real significance in itself. Deviation is labeled E or W when it is entered in the column to facilitate combining it with variation. Labelling it E or W is not difficult. Inasmuch as the compass deviation card in the airplane has two columns labeled "for" and "steer," and these refer to the same numbers as the columns labeled "magnetic" and "compass," each of these columns is labeled with two names. These entries for deviation and variation should be figured out on the ground before flight and entered in their proper columns. To fill in the deviation column and label it E or W note on the compass deviation card which value is the greater, the magnetic (for) or the compass (steer). If the magnetic is larger the deviation is easterly. Remember the rule "Add Easterly When Correcting." This rule applies to deviation as well as variation.

The column labeled wind direction and velocity is very easy to understand but difficult to fill in accurately. In the system of navigation which is used in conjunction with this card it is not necessary to fill in this column, but it helps to do so. A navigational computer is necessary in case it is desired to compute the wind. The last two columns on the card are used to record the fuel on hand at the start of the trip or at any point. The column labeled GPH (gallons per hour) is used to record fuel consumption.

In order to use this card, special preparation of the chart is also necessary. This undoubtedly sounds like a great deal of work just to make a cross-country flight, but after trying it a few times, you'll agree that you've been repaid many times for the effort expended. In addition to the line which is customarily drawn on the chart connecting the points of departure and destination, drift lines are drawn diverging from the point of departure. These lines are about one inch long and on the chart at about 15 minutes flying distance out. The point of departure can be taken as the airport, but preferably should be some point far enough away from the airport and along the

(*Continued on page* 132)

FOR IDENTIFICATION

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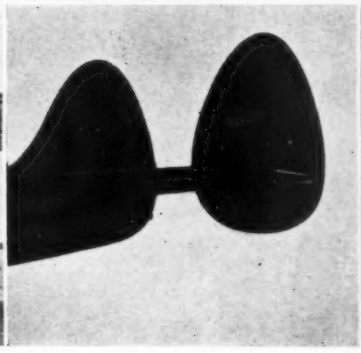

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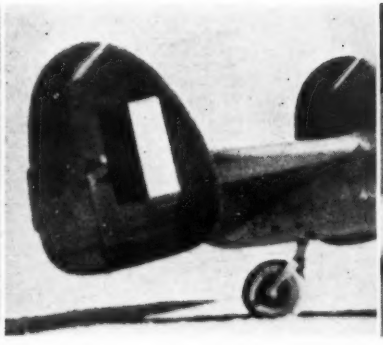

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The planes are: 1. Stinson (Vultee) O-49 (Vigilant); 2. Lockheed "Constellation"; 3. Interstate "Cadet" or L-6; 4. North American "Texan" (SNJ or AT-6); 5. Fairchild "Yankee Doodle" (AT-21); 6. Messerschmitt Me-110; 7. DeHavilland "Mosquito"; 8. Junkers Ju-87.

MISTAKEN IDENTITIES

FREQUENTLY confused in aircraft recognition studies are the bottom views of the North American *Mustang*, Focke-Wulf Fw-190 and Messerschmitt Me-109E. These views are shown below, to exact scale. It is notable that the *Mustang* is largest; the Messerschmitt is unusually small. All have squared wing tips and moderate taper.

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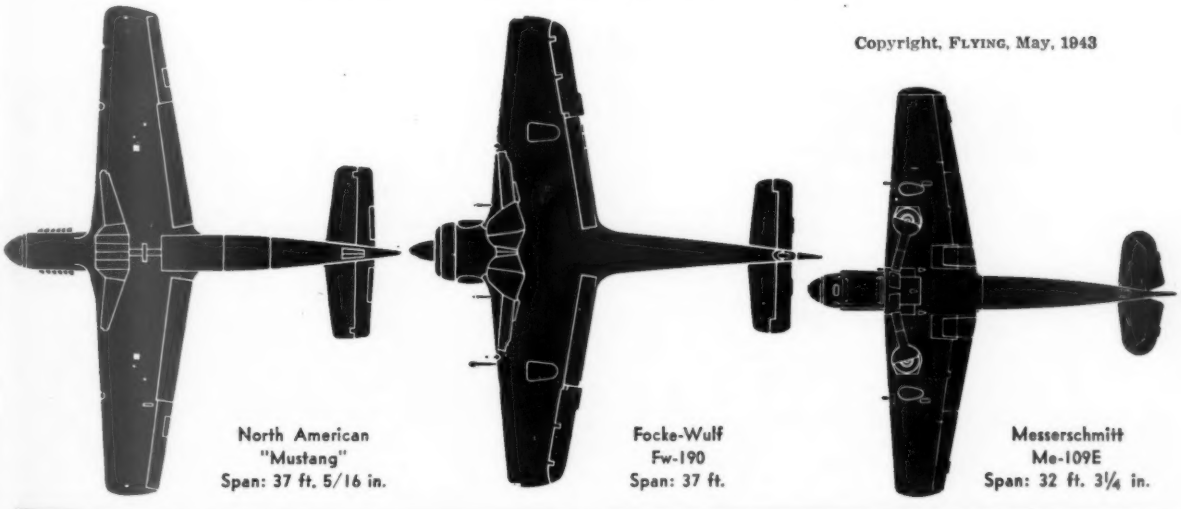

North American "Mustang" Span: 37 ft. 5/16 in.

Focke-Wulf Fw-190 Span: 37 ft.

Messerschmitt Me-109E Span: 32 ft. 3¼ in.

CURTISS "WARHAWK"

Fighter

PERTINENT FACTS: Technical designation of the *Warhawk* is P-40F. One of the most outstanding differences between this airplane and preceding P-40's is the *Warhawk's* Packard-built Rolls-Royce *Merlin* engine (1,260 h.p.), instead of the Allison. A recent joint announcement by the U.S. Army and Navy to the effect that all P-40's in the future should be referred to as *Warhawks* is technically inaccurate. The actual *Warhawk* differs considerably from earlier *Kittyhawks* and *Tomahawks*. If such a system is applied, the P-40F would have to be called the *Warhawk IV*, following the British system. Wing span of the P-40F is 37 ft. 4 in., length is 33 ft. 4 in., height, 10 ft. 7 in. Gross weight is 9,080 lbs., empty weight 6,590 lbs. Top speed is 370 m.p.h., cruising 300. Normal range is 900 miles, service ceiling 30,000 ft. Armament is six .50 caliber guns. All figures are from official sources and undoubtedly conservative.

WHAT TO LOOK FOR: The *Warhawk* is a conventional low-wing monoplane. The cantilever wing has moderate dihedral, very slight taper on the leading edge, but pronounced taper on the trailing edge. One way of telling the *Warhawk* from its predecessors is the fact that the top of the cowl is smooth and unbroken by air intakes or guns. Note bulging "knees" of landing gear in the front view.

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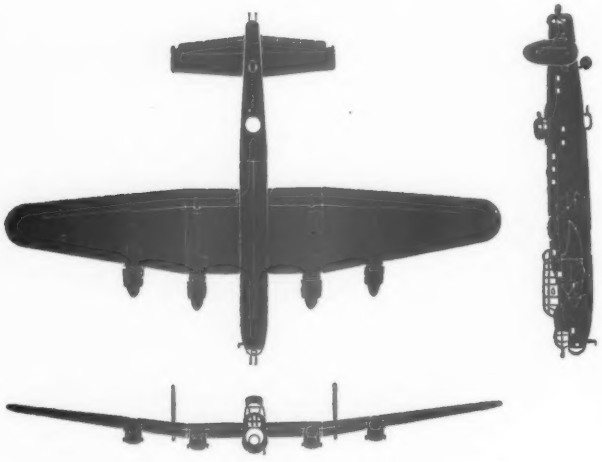
AVRO "LANCASTER I"

Heavy Bomber



PERTINENT FACTS: With the Short *Stirling* and Handley-Page *Halifax*, the *Lancaster* completes the RAF's trio of current heavy bombers. The *Lancaster I* is powered with four 1,175 h.p. Rolls-Royce *Merlin XX* liquid-cooled engines; also in use is the *Lancaster II*, the same airplane powered with air-cooled radials of comparable horsepower. Span is 102 ft., length is 69 ft. 6 in., height 20 ft. 6 in. Gross weight (including eight tons of bombs) is 60,000 lbs. Maximum speed is about 300 m.p.h., maximum range about 3,000 miles. Primarily a night bomber, its armament only consists of 10 .303 caliber machine guns.

WHAT TO LOOK FOR: A mid-wing cantilever monoplane, the *Lancaster's* wing has pronounced dihedral in the outer panels and leading and trailing edge taper. The four engines hang well below the wing. Fuselage is long, narrow but deep. The tail has twin rudders. Gun turrets in tail, nose and fuselage.

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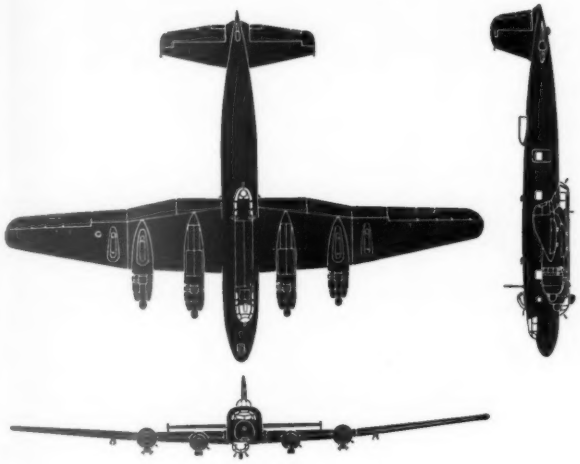
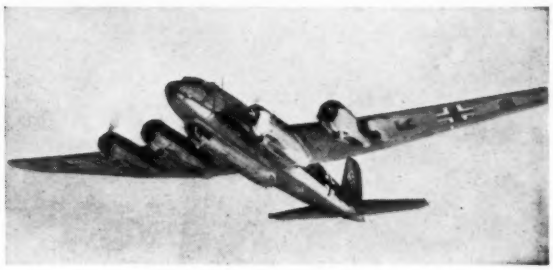
FOCKE-WULF "KURIER"

Long-range Bomber





PERTINENT FACTS: Technically the Fw-200K, the *Kurier* is a military conversion of the Focke-Wulf *Condor* airliner. This fact is emphasized by the variety of equipment "tacked on" externally. Current version of the *Kurier* is powered with four 1,600 h.p. air-cooled BMW radials. Wing span is 108 ft. 6 in., length 78 ft. 3 in., height 23 ft. 4 in. Maximum speed is 279 m.p.h., cruising about 220. Range is 2,300 miles, service ceiling 28,000 ft. Gross weight is 48,500 lbs. It carries a crew of six. There are numerous modifications of this airplane; one widely-used version has one 20 mm. cannon and five machine guns.

WHAT TO LOOK FOR: The low cantilever wing has slight dihedral from the center section out. There is compound taper on the leading edge; the trailing edge is peculiarly shaped, particularly in the center section. The fuselage is squarish and carries an offset "dustbin" or gondola which houses gunners and bombs. There are external bomb compartments underneath the wing and outboard engines. Landing gear is retractable.

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FIESELER "STORCH"

Observation-Liaison

PERTINENT FACTS: Storch is the German word for stork. The Fieseler Fi-156K is so named because of its unusual flying characteristics. Fully equipped with slots, flaps, large wing and wide landing gear, the *Storch* is the German liaison plane that served as the model for the number of liaison types now used by the U.S. Army. Engine is a 240 h.p. Argus air-cooled inline, which gives it a top speed of 109 m.p.h. Span is 46 ft. 9 in., length 32 ft. 6 in., height 10 ft. Gross weight is 2,772 lbs. Service ceiling is 17,000 ft. The *Storch* carries three men and has a single machine gun firing toward the rear.

WHAT TO LOOK FOR: Externally-braced high wing with straight leading and trailing edges and blunt tips. Slots and flaps from tip to tip. Fixed landing gear and externally-braced tail. Tapered and rounded tail.

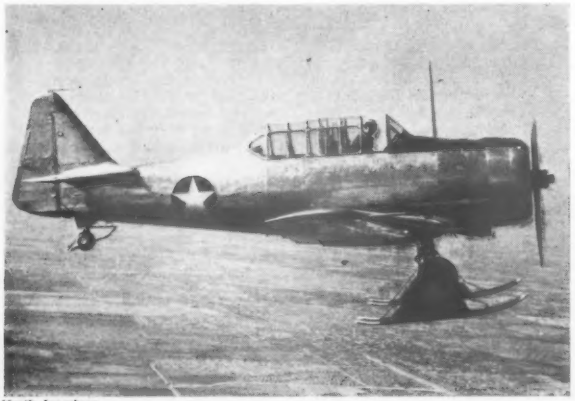
Copyright, FLYING, May, 1943.

Consolidated

Double assembly line at new Fort Worth Consolidated plant produces "Liberator" bombers and cargo planes. Unlike transports, bombers (foreground) have "paddle" props. Third from front is a PB4Y Navy patrol bomber.

HAVE YOU SEEN?

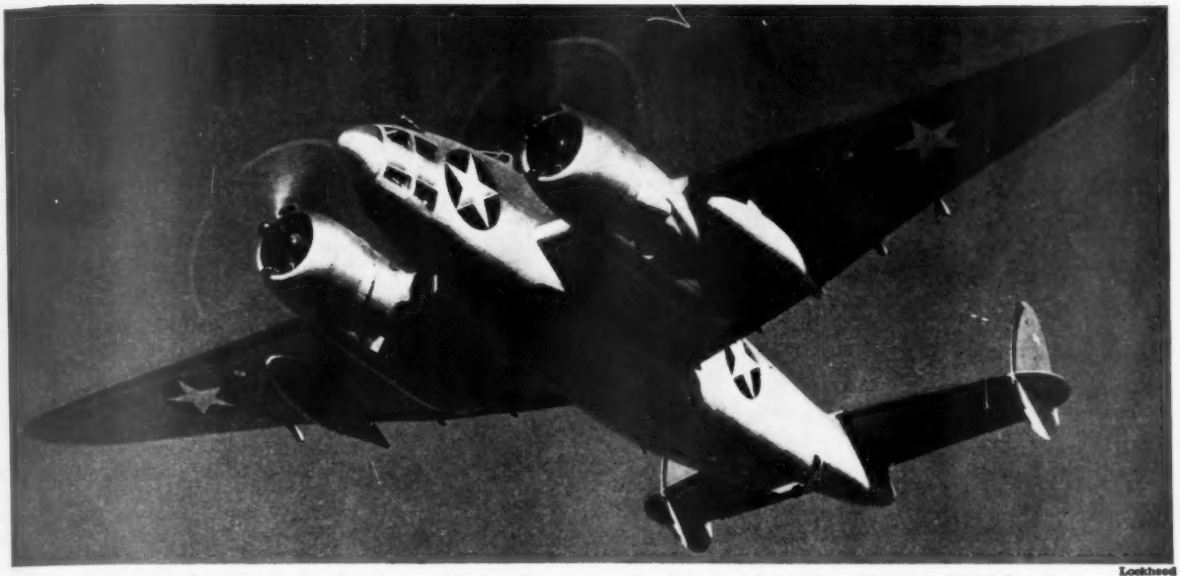
Designed for use in snow, this novel ski-wheel gear is on North American "Texan" (AT-6, SNJ). It was dubbed "Swoose."



North American

Entire nose of this giant Waco glider is hinged to permit carrying a jeep and undisclosed number of men and equipment.

Acme



Lockheed

Designed and equipped to combat the coastal submarine menace, Naval version of the Vega "Ventura" (PV-1) has droppable gas tanks and more radio equipment than any plane built by Lockheed or Vega. Motors are 2,000 h.p. radials.

International

While on assembly line, North American P-51 wears rubber-saving wooden wheels.

U.S. Army

Two-place helicopter (XR-4) now being tested by the AAF cruises at 60 m.p.h., and weighs 2,400 pounds. Ordered in 1941, its motor develops about 125 h.p.

Almost the same airplane as is being used by the American airlines, this Douglas "Skytrooper" (C-53) hugs the ground as it passes a truck convoy in Africa. Usually unarmed, C-53's often fly low and stay out of the way of enemy aircraft.

Acme

I Learned About Flying From That!—No. 45

by T. H. CHAMBERLAIN

Carelessness in small details brought this British pilot's African flight to a finale.

THERE is a saying "It is the little things in life that count." Certainly it is the "little things" in aviation that count. Through overlooking small things, many good planes have finished on the scrap-heap and many good pilots have prematurely ended brilliant careers.

Early in 1933, I had completed arrangements for a flight to South Africa. My object was not to break records, but to represent a well-known patent food company and visit their branches on my way through Africa. In other words, I was to be Great Britain's first air commercial representative to the colonies.

My plane was a twin-engined monoplane, the Segrave *Meteor*. It was designed by Sir Henry Segrave, the racing driver, and built by the Blackburn Aeroplane Company of Brough, Eng. The *Meteor* had two De Havilland *Gypsy III* engines of 120 h.p. each, giving the plane a cruising speed of 145 m.p.h. and a range of 500 miles.

The last days before the takeoff from Croydon Airport were spent in checking over the whole aircraft, seeing that the gauze covers were handy for fitting to the induction pipes when we reached the desert of north Africa. We had the pants taken off the wheels. These could spell disaster in case of a forced landing in soft sand or heavy mud.

My co-pilot was a young fellow who was keen to get experience flying abroad. On March 27, 1933, we took off from Croydon and headed for Paris. Our route to the Cape was via Marseilles, Genoa, Rome, Sicily, Tunis, Tripoli, Benghazi, Cairo, Khartoum, Juba, Nairobi, Broken Hill, Johannesburg and thence to Cape Town. We made good time to Tunis, where we fitted extra accessories to cope with the sand which otherwise would clog every pipe and part of the aircraft. At each stop we made along the north African coast we cleared the gauze covers, refitting them before taking off.

On reaching Cairo the plane was put into the hangar for a check-over, while I went into the Egyptian capital to visit the agents of the company I represented. While there I met Elly Beinhorn, the German aviatrix, who was on a flight to South Africa in a small Heinkel monoplane. She was having trouble getting permission to fly over the Sudan. The government would not allow her to proceed past Wadi Halfa unless she had an escort.

Over a cup of tea on the terrace of Shepherds' Hotel, I agreed to leave three days later and accompany her as far as Juba, which meant that she would be escorted the whole way across the Sudan. We left Cairo at three o'clock in the morning, making a night flight to Assuan. There we refuelled and flew on to Wadi Halfa. Here we stayed the night and again cleaned out the gauze covers.

The following morning we left for Khartoum, arriving there at noon. As Miss Beinhorn had some business to attend to at this stop and I had my agents to see, we decided to leave for Juba two days later, which was Easter Saturday.

Miss Beinhorn took off first because of the heat and the heavy load she was carrying. In addition to her personal kit she had a movie camera and many reels of film; spare cans of oil and many other things. We had two of her bags in our machine.

As she climbed for altitude we took off and headed south for Malakal, our first refueling stop. From here to Juba, a distance of 400 miles, we had to fly over the Sud country, waste land dreaded by all airmen in that part of the world. A forced landing in the swamps of the Sud meant a 99 per cent chance of a complete wreck and probably the death of the pilot.

We climbed to 8,000 feet. Because of the load we had, we could not get any higher. Underneath, we saw the swamps and patches of black cotton soil which when wet by rain became a quagmire.

At noon we had covered half the distance. Then our troubles began. The needle on the starboard oil gauge began to flicker, then slowly crept back until it reached zero. We looked out and saw oil running over the engine cowling. It was coming out of the propeller spinner at every turn of the prop. Easing back the throttle, we waited for any effects this loss of oil would have. We decided to keep on, relying on the remaining engine to get us as far as an emergency field at a small village named Bor on the Nile 100 miles further on. This decision was never carried out for, with a loud report, the cowling of the port engine came loose and began to flap about in the propeller slipstream. One glance at that and we knew if it came off completely, it would fly straight back into the tail and spell curtains for us. I eased the other throttle back and put the nose down. There was nothing to do but get down, and quickly. Turning away from the river and surrounding swamps, we headed east—slowly losing altitude and looking for some place to land.

Miss Beinhorn flew alongside, having seen the red Very light we had fired through the window to tell her we were in trouble. The starboard engine now was useless, having frozen. Ahead, we saw a native village with what appeared a clear space by the huts. Deciding to land there, we gave all our attention to nursing the surviving motor to get that far.

Coming in to land, the needle on the airspeed indicator pointed to 90 m.p.h. We were about 30 feet from the ground when the machine fell out of our hands and, with a crunch of breaking metal and splintering wood, we hit the ground to bounce and slide along to a stop. Reflex heat from the ground had caused the stall.

We sat still for a few moments, dazed by the crackup. Then we got out to see what the damage was. We listed a broken wheel, a bent axle, one inner-tube split beyond repair, starboard wing fabric torn (leaving a large hole), ribs broken and main spar damaged but not broken.

Elly Beinhorn flew around in circles. We waved to her and picked up the broken wheel and held it up for her to see. She dipped her wings and flew off toward Juba. We did not see her again for four years.

We set out the following day to walk to Bor, to get what help we could. Our subsequent adventures would fill a large sized book, but we returned to the scene of the forced landing two weeks later.

(*Continued on page* 167)

Airborne Commandos

THE part Piper L-4 planes are playing in the war today is just the beginning. Their wartime abilities, already proved on the battlefronts of the world, point the way to new and important uses.

Their ability to land and take-off quickly almost anywhere, the ease with which they can be hidden and their remarkable maneuverability may well be the means of developing a new kind of Commando warfare. Piper L-4 planes could set down American Commandos behind enemy lines. And, when the boys completed their missions of destruction, these planes could get them back with speed and comparative safety.

When victory is won, a peacetime version of this remarkable Piper plane will carry you quickly and economically on vacation and business trips . . . saving you time and money . . . and giving you great enjoyment.

FREE BOOKLET ON HOW TO FLY Send today for your copy of the easy-to-understand booklet "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. PA53, Lock Haven, Penna.

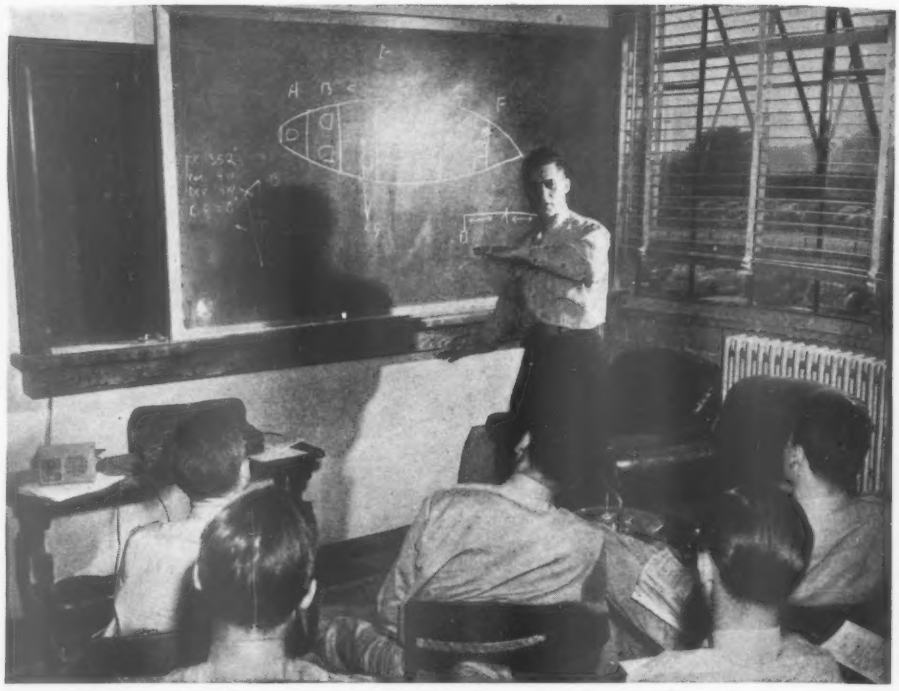
16mm. SOUND FILM—"The Construction of a Light Airplane" now available. For point of nearest distribution, write the producer: Supervisor, Audio Visual Aids, Extension Services, Pennsylvania State College, State College, Penna.

PIPER POINTS THE WAY TO WINGS FOR ALL AMERICANS

★

Lieutenant McIntyre gives his students some pointers on navigation. Far from being a "desk pilot," he tells fledglings how to do things, then shows them.

★



ACCIDENT PREVENTER

by FRED VAN DEVENTER

ARMY practice forbids stunting in Army planes, but—

There he was, flying a P-39 *Airacobra* intercepter pursuit ship, diving, twisting and turning in all the gyrations of an aerial circus, while the commanding officer, his staff and other pilots watched him.

He was trying to find out why one of the base's best pilots had gone into a flat spin.

When the plane swept back to the field, the pilot—a tall, lean man in dirty dungarees—beckoned to the crowd of pilots and led them to the base's lecture room. For 15 minutes he talked.

This plane couldn't go into a spin unless it was forced into it, or there had been an accident.

This tall, lean man had gone up to prove it, and in proving it he answered the question I went to the field to ask:

"Why are there so few accidents at this army air base?"

Unanimously, the officers had replied: "Bob McIntyre."

Lieut. Bob McIntyre—the 26-year-old who had done the aerobatics—is the chief of the transition school, Third Ferrying Group, Air Transport Command, U.S. Army Air Forces.

In the last four months, Detroit air base pilots have spent some 15,000 hours in the air, delivering bombers and fighters and learning to fly them. In that time there have been but two fatal accidents, neither attributable to pilot error, only 31 accidents altogether, most of them minor.

Those figures are far below the average prior to April, 1942, when the transition school was established.

Literally thousands of Army flying craft—everything from training ships to the giant four-motored bombers—have been delivered by these pilots.

They fly a different ship almost every time they go into the air—and they're bringing them down safely.

Of course, Lieutenant McIntyre says there is more to the flying safety of his pilots than just his teaching.

"I have an excellent staff of instructors," he said. "But just as important, we know the airplane is ready to fly before it takes off."

There is a very great tendency for the young flyer to be what he thinks the public expects him to be—a daredevil—rather than what he should be—a master precisionist.

But McIntyre's students are precisionists. If they are not, they don't fly.

He has huge blackboards showing the name of every pilot, and beside their names are checks to show just what type of planes they may fly. Only Lieutenant McIntyre may alter those check marks. Every student of the transition school must have had 300 hours in the air before even entering. These include accomplished civilian pilots, airline pilots and pilots of puddle jumpers, as well as graduates of Air Force flying schools.

McIntyre is no schoolmaster. He leans against a chair, or sits down as he talks. His classes are no places for book worms. Book instruction is rather incidental.

If he can't explain with words what he wants to say, he grabs anything handy to illustrate his point. He picked up the top of a box, tore the corners, and wiggled them around to show how ailerons on a certain ship worked.

If he can't explain his point that way, he leads the class to the hangar, groups the pilots around the plane in question and shows them.

That was what prompted him to test the P-39 above the field. The pilots wanted to know what to do if their craft should go into a spin.

He showed them, and then while the subject was still fresh in their minds, he told them. They popped questions and he answered them, quickly, precisely and with gestures.

"What would *you* do if your plane went into an uncontrollable spin," asked one of the pilots.

"Don't quote me," McIntyre replied, "but when such a thing happened—uncontrollable mind you—I'd start getting out of that plane—and quickly."

Stupid question?

Not to Lieutenant McIntyre.

"My office is open always for any pilot who wants to ask questions—no matter how stupid," he said. "And they do. If I can't answer them, I can show them."

END

"COMPARED TO THIS OCEAN-HOPPING, flying a transport over the Blue Ridge was duck soup. All you did then was hang onto a beam. But, brother, it's different now. There aren't many signposts on the way to Africa except the dials on your instrument panel. And when there's nothing in sight but salt water, those dials are mighty comforting.

"After the war, I guess I'll be back behind the wheel of a passenger plane again but I'll probably still be flying by instruments . . . in the stratosphere . . . non-stop from coast-to-coast. Well — as long as I've got instruments I can depend on, I'll say that's the way to get there."

WHAT TOMORROW'S PLANES *will look like or how they will perform, we don't exactly know. But we do know that Kollsman research engineers are constantly planning and developing new and better precision aircraft instruments . . . to help smooth out tomorrow's skyways, and give safer wings to a nation at peace.*

THE KOLLSMAN SENSITIVE AIRSPEED INDICATOR, *used for close navigation and precision bombing, has a range of 700 m.p.h., and can be read to within a few miles per hour at any speed.*

KOLLSMAN
AIRCRAFT INSTRUMENTS
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ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

CAR TO THE AIRPORT

by LYNN H. KERRINGTON

Fares are high, whether by limousine or decrepit taxi.

Believe it or not, it may cost you 13 times as much per mile to ride to airports as it does to fly after you get there. These figures show why.

YOU pay anywhere from 1½ to 13½ times as much per mile to ride in taxis and buses between airport and city, than you do to travel by air. This is an astounding fact, particularly in view of the more or less popular belief that to travel by air is more expensive than any other form of transportation.

These unusual figures were compiled from standard rate tables published by two of the nation's leading airlines in a recent issue of the Official Guide of the Airways. They indicate the fare one unaccompanied airline passenger must pay. The figures were converted to a cost-per-mile basis, with the result that some highly interesting cab fares were discovered.

The most expensive city in the United States to visit—if, of course, you plan to take a cab from the airport to the city—is Boston, Mass. This city leads all others with a charge of 75 cents for a one-mile ride—which is 13½ times the 5.5 cents per mile it costs to travel on an airline! Second most expensive airport-to-city cab ride in the U.S. is to be found at Del Monte, Cal.: 75 cents for 1½ miles, or 50 cents per mile. Hartford, Conn., comes third, charging 37½ cents per mile. There are several other cities whose cab or bus companies charge 30 cents or more. They are: Huntington, W. Va., 33½ cents; San Diego, Cal., 33.2 cents; Fresno, Cal., 32.6 cents; Big Springs, Tex. and Rochester, Minn., 30 cents.

If, for instance, the airlines charged 30 cents per mile, it would cost nearly $240 for the one-way flight from Chicago to New York. If they charged Boston's 75-cent rate, the Chicago-New York flight would cost about $600.

To outward appearances, it would seem that taxi and bus companies in those cities having airline service fix charges at whatever rate the traffic will bear. If one can judge by the figures compiled here, the city most considerate to the airport-to-city passenger is St. Louis, Mo., with a charge of slightly under seven cents per mile. However, the cheapest rate we found was not in the U.S.; the company at Toronto, Canada, has the lowest rate we came across: 5.6 cents per mile—almost equal with the cost of travel by scheduled air transport.

The higher rates seem to be found in the smaller cities of the U.S. In the 25-cents-per-mile bracket are Billings, Mont.; Cheyenne, Wyo.; Fargo, N. D.; Johnson City, Tenn.; Moline, Ill.; and North Platte, Neb. The four-mile ride from Washington's new National Airport costs 90 cents, or 22½ cents per mile.

The charge at Detroit is 16.7 cents per mile, Omaha is 15, Salt Lake City, 14.2; Seattle, 13.6; New York City, 12½; Denver, 11½; Minneapolis, 10; Pittsburgh, 9½; Chicago, 8.3, San Francisco, 7.7; and so on. Compared with those cities mentioned at the beginning of this article, these latter charges are just a step above charity.

If these rates are projected even further, some interesting figures turn up in connection with the big oversize limousines which carry airline passengers in such cities as New York, Chicago, Detroit and Buffalo. Bear in mind that each passenger pays the stated rate, whether or not he is the only one in the coach. Take New York City, for example. At that city's already-mentioned 12½-cent-per-mile rate, one such limousine carrying 10 passengers will take in a gross of $10 (excluding tax) for a one-way, eight-mile trip. That's $1.25 per mile gross for the car—which is just an over-size sedan of the moderately expensive variety. Obviously, the coaches do not carry 10 passengers on every trip—but there should be plenty of margin, at such prices. Incidentally, compare that $1.25 figure with the 60 or 70 cents per mile it costs to operate a Douglas DC-3.

"Airlines demanding that equipment carrying passengers to and from the airport be 'up-to-date' partially result in the high cost of transportation in Chicago," declared an officer of one limousine company. New chassis are purchased every 100,000 miles (about every two years). Bodies must be specially made at the factory.

It was also pointed out that in Chicago, the limousine rate is far cheaper than the taxi hire to the airport. The cars, carrying up to 12 passengers, make the trip for about a dollar, while the taxis charge in the neighborhood of $2.50, depending on where the trip originated. Approximately 12 limousines are on the Chicago airport run.

In Boston's case, it may be argued the one-mile trip is so short as to justify the fare charged as a "minimum." In other words, a passenger riding in a metered

(*Continued on page* 82)

MITCHELL BOMBERS FIND GOOD HUNTING IN NEW GUINEA

Giving Japs no rest...they pound ships, ports, munitions dumps, planes, airfields

B-25 Mitchell bombers attacked a Japanese convoy attempting to land troops on the north coast of New Guinea. Several destructive hits were scored on transports and escorting warships, five Zeros were shot down and the whole convoy fled...

"B-25's made the heaviest attack in weeks on Salamaua. The port was badly battered and ravaged by fires and explosions. A munitions dump was blown up...

"In two runs over the Jap airdrome at Lae, B-25 Mitchells destroyed five bombers and six fighters on the ground...

"B-25's located a Jap destroyer and two smaller vessels attempting to bring supplies to New Guinea and sank all three..."

You could fill a book with the list of Jap losses in New Guinea. Into this bottomless pit the enemy has poured men, ships, supplies and planes in a desperate effort to conquer the island. Instead they suffered their first major land defeat of the war in the South Pacific.

On this front, as on many others, "North American Sets the Pace." Powerful North American B-25 Mitchell bombers, more hated by the Japs than any other United Nations planes, have been active in the New Guinea theater for more than a year. At Gona, Buna, Lae, Salamaua and every other point where there were Japs to be killed, the B-25's found good hunting.

Today, with New Guinea safely in Allied hands and the threat to Australia smashed, B-25 Mitchells are out to blast the enemy from his other bases in the South Pacific. Back home in North American's plants the hunting goes on too. We're looking for, and finding, many improvements that keep us ahead of the Axis.

The Office of War Information says of the B-25: "No other airplane of its type in friendly or enemy air forces is known to equal it." The Japs in New Guinea found that was true. We mean to keep it that way.

NORTH AMERICAN AVIATION, INC.

Inglewood, California
Kansas City Dallas
Member, Aircraft War Production Council, Inc.

B-25 MITCHELL

P-51 MUSTANG

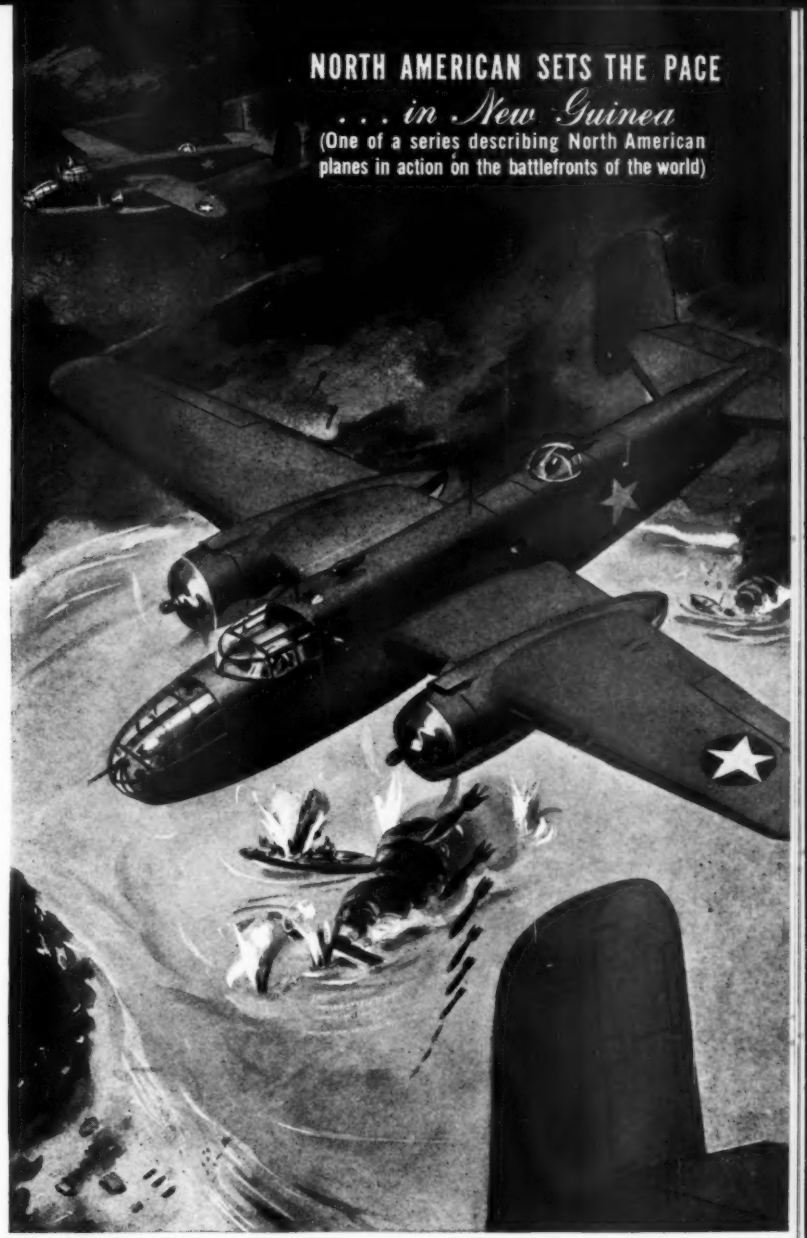
AT-6 TEXAN

The Japs hate Mortimer and with reason. This North American B-25 Mitchell bomber has its individual record painted on the fuselage: four flags, one for each Jap sunk, nine rising sun emblems, one for each Zero shot down, and 17 bombs, one for each raid in which the plane took part. Mortimer has room for more flags and emblems. He symbolizes that unconquerable superiority which infuriates the Japs.

NORTH AMERICAN SETS THE PACE

. . . in New Guinea

(One of a series describing North American planes in action on the battlefronts of the world)



Deadly B-25 Bombers attack a Jap beachhead. Like American planes everywhere, they are painted a camouflage color to match the natural setting in which they are based —in this case, the vivid green of the New Guinea jungle.

NORTH AMERICAN *Sets the Pace!*

Back in Action...THANKS TO WINGS

Evacuation of the wounded by air... sulfa drugs... blood plasma. These three mercy miracles of the war are making possible the greatest number of recoveries in the history of human conflict! We are proud and grateful for the major role Douglas Skytrain, Skytrooper and Skymaster transports play in this life saving drama. Douglas airplanes on every front are daily flying troops and supplies into battle, then returning the wounded to base hospitals *in time*.

Douglas Aircraft Co. Inc., Santa Monica, Calif.

Long Beach • El Segundo • Tulsa • Oklahoma City • Chicago

WINGS OF MERCY AS WELL AS WAR

C-54 "Skymaster" C-47 "Skytrain" C-53 "Skytrooper" A-20 "Boston" A-20 "Havoc" SBD "Dauntless" A-24 "Dauntless"

DOUGLAS

Largest Builder of Cargo and Transport Aircraft

MEMBER, AIRCRAFT WAR PRODUCTION COUNCIL, INC.

Letters

Navy Issue:

Sirs:

This excellent volume is particularly interesting to me because of my long association with Naval aviation, and I will keep it among my souvenirs. It is extremely well done.

E. E. WILSON
President
United Aircraft Corporation
East Hartford, Conn.

Sirs:

This issue is exceedingly well done and will be a valuable reference work.

ROBERT H. HINCKLEY
The Sperry Corporation
New York, N. Y.

Sirs:

This issue is one of the finest pieces of literature I have seen in a long time. I am putting it in my library with other aviation data which I have collected during my two years in Government service—and for years prior to that when I first became interested in aviation. My congratulations to you and your organization in producing such a fine book.

MERRILL C. MEIGS
The Hearst Corporation
Chicago, Ill.

Sirs:

The subjects of these issues [RAF and Navy] are so well covered that I have used them as part of a reading course for new personnel who are assigned to my branch in the Bureau of Aeronautics.

STEADMAN TELLER
Commander, USN
Bureau of Aeronautics
Navy Department
Washington, D. C.

Sirs:

It is very interesting and does indeed give a splendid picture of the activities of this arm. I shall keep this volume handy.

JOHN J. PERSHING
General, USA (Ret.).
Washington, D. C.

Stinson vs. Vultee

Sir:

Will you please tell me if that liaison plane pictured on page 57 of the March issue of FLYING is, as you have captioned it, 'a Vultee liaison.' Several other well known air magazines have the picture of the same plane and they call it the "Stinson *Sentinel* (L-5)."

RUSSELL M. O. JACOBSEN
Hollywood, Md.

● According to the latest official release naming the planes used by both the Army and Navy, the plane referred to is the Vultee *Sentinel* (L-5). Vultee owns the Stinson plant where these planes are manufactured. However, both names still are commonly used.—Ed.

Comparative Ranks

Sirs:

In your February issue of FLYING you show comparative ranks of the RAF and U. S. air forces. It is, however, printed in a manner which is most misleading. I am an American in the RCAF and well into my third year of service. I think it fitting that this matter be clarified as I have received several letters from friends . . . who read FLYING and . . . who thought my rank was equal to that of captain (in the Army). They asked me why I told them this when actually "a flight lieutenant compares with a first lieutenant in the Army."

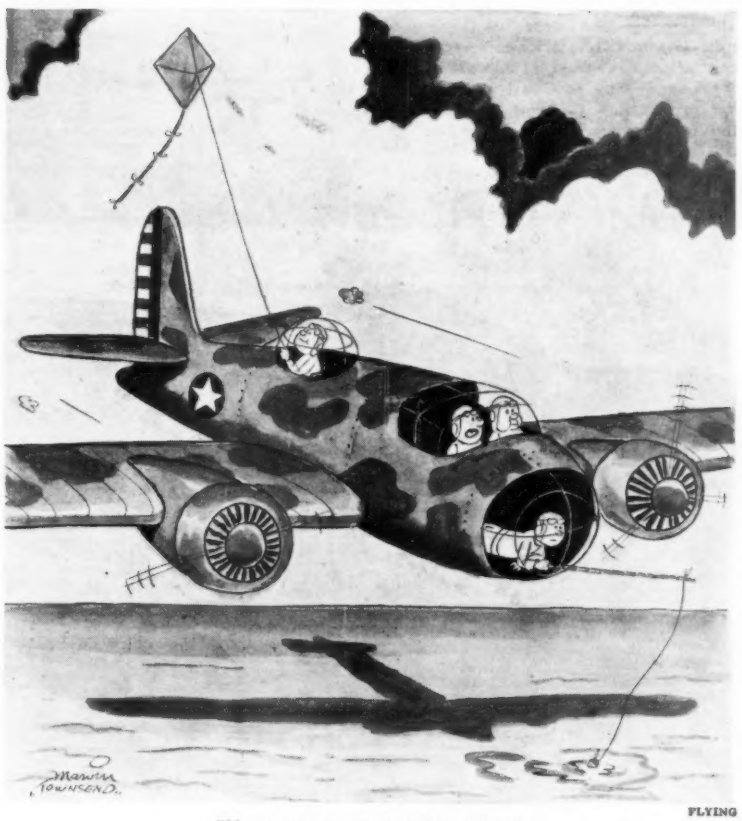
"Flight Lieutenant"
RCAF

● The table in the February issue was correct—with one exception. In making up the page, the printer moved the right-hand column of type up one space. Not suspecting the error, we missed it on the page proofs. The table is reprinted below correctly. The Marshal of the RAF is, in reality, King George VI. The only comparable "rank" in the United States, then, would be President Roosevelt.—Ed.

RAF	USA
Marshal of the RAF	
Air Chief Marshal	General
Air Marshal	Lieutenant General
Air Vice-Marshal	Major General
Air Commodore	Brigadier General
Group Captain	Colonel
Wing Commander	Lieutenant Colonel
Squadron Leader	Major
Flight Lieutenant	Captain
Flying Officer	1st Lieutenant
Pilot Officer	2nd Lieutenant

RAF	USN
Marshal of the RAF	
Air Chief Marshal	Admiral
Air Marshal	Vice Admiral
Air Vice-Marshal	Rear Admiral
Air Commodore	Commodore*
Group Captain	Captain
Wing Commander	Commander
Squadron Leader	Lieut. Commander
Flight Lieutenant	Lieutenant
Flying Officer	Lieutenant (jg)
Pilot Officer	Ensign

* Rank of commodore is no longer filled in the Navy, although legislation recently was introduced in Congress to re-instate this rank, subject to Senate consent. A commodore would be equal in rank to a brigadier general in the Army.

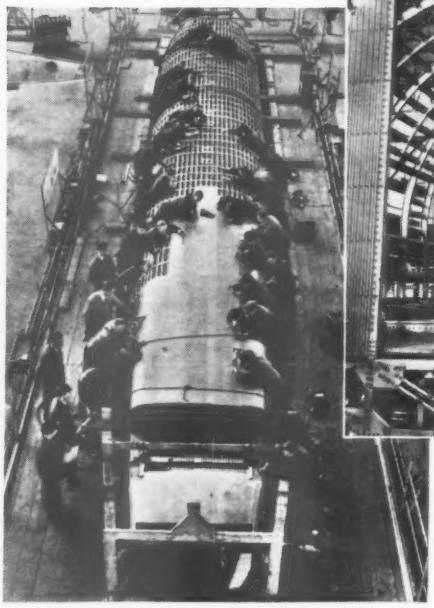


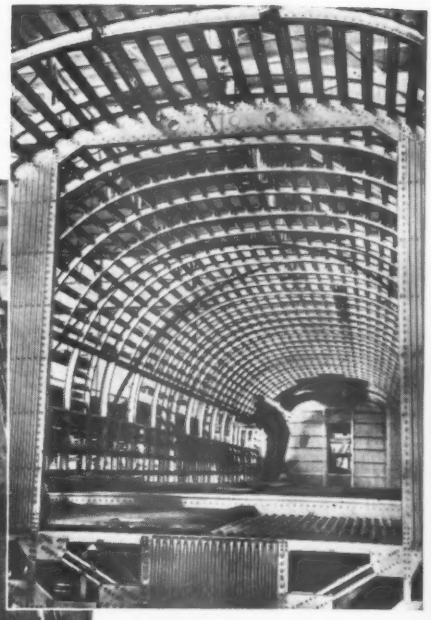
"Hope we see some action soon. I think the men are getting bored!"

The Junkers Ju-90 had air-cooled engines on its "friendly" flight to London in mid-1939.

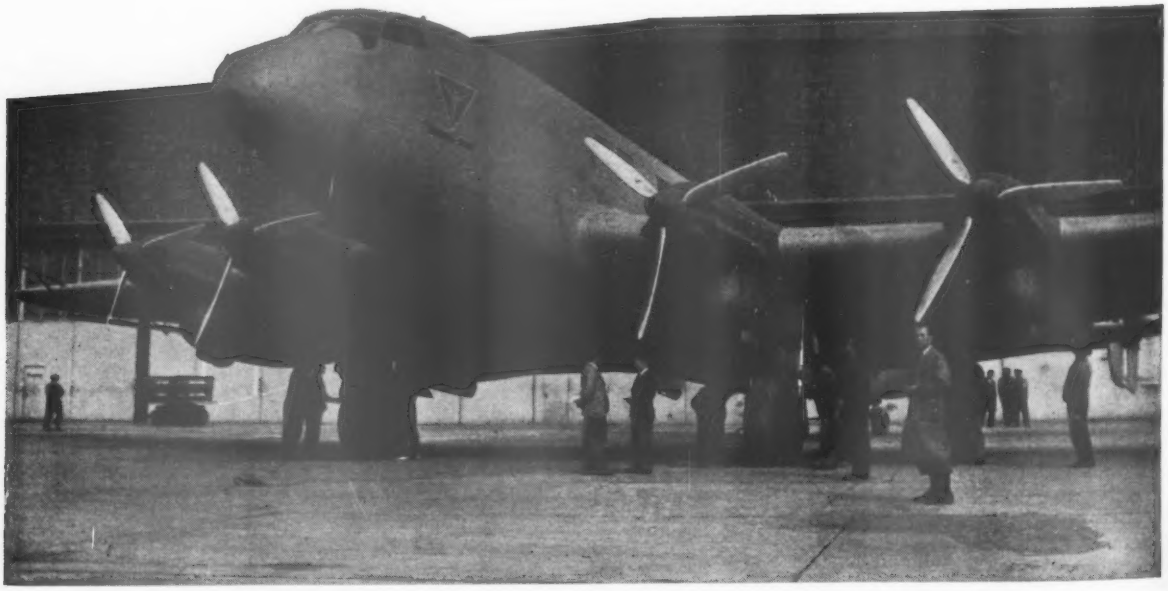
BIG NAZI

LOST in the background of Germany's vast Luftwaffe is the little-realized fact of the Nazis' early development of transport planes using four engines and capable of carrying 40 passengers, in addition to a crew of four. Comparable to the Douglas "Skymaster" is the Junkers Ju-90 which, shortly before the outbreak of war, landed at Croydon airport, London, to pay a friendly visit. Rare production pictures of this big plane (wing span, 114 ft. 10 in., length 86 ft. 3 in.) were secured from Germany by FLYING before the war and are shown on this page. The Ju-90, as a troop-cargo carrier, has been reported on many fronts.

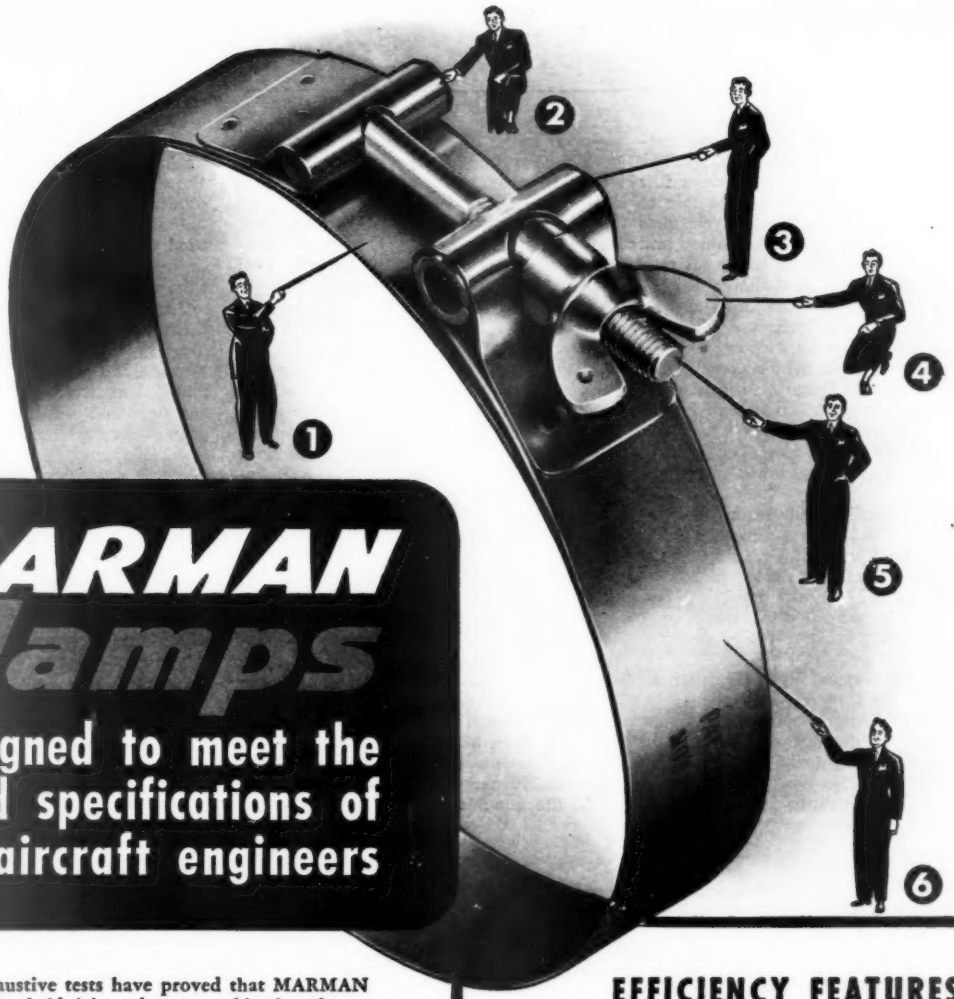




Covering duralumin monocoque fuselage (left). The tail-piece and nose are detachable. An interior view of fuselage (above).



Powered with Junkers "Jumo 211" engines, Ju-90 cruises at 200 m.p.h., has top speed of 250 m.p.h.



MARMAN clamps

Designed to meet the rigid specifications of all aircraft engineers

Exhaustive tests have proved that MARMAN Clamps hold tight under any combination of pressure, stress, vibration, fire or weather exposure. They require less time in motor assembly due to patented design, which permits clamp to be easily and quickly wrapped around hose and duct section without its removal and tightened the desired amount with one hand.

As compared to conventional clamps, MARMAN is giving the aircraft industry stronger clamps, for longer service, while eliminating costly, time-consuming operations. MARMAN Clamps weigh substantially less than other clamps of the same strength —which is another vital reason why aircraft engineers specify them for many American war planes.

MARMAN Clamps NOW used by
Consolidated, Vultee, Douglas, Ford, Rohr, Northrop, Solar, Wright, Briggs, Budd, Chrysler, Boeing and others.

Our experience is at your service for standard and special MARMAN Clamps. Write today for information. We are prepared to make prompt deliveries.

EFFICIENCY FEATURES

1. **A 360 degree clamp installed either as a preformed unit or by wrapping around hose already in place.**
2. **Under maximum tension no part of clamp is highly stressed, hence no distortion occurs.**
3. **Circumferential tension is uniform around any convex surface.**
4. **No reverse torque necessary, even under extreme conditions, for clamp removal.**
5. **Clamp may be removed and reinstalled *repeatedly* with no loss in efficiency.**
6. **Standard sizes 1⅛" to 38" in diameter.**

MARMAN PRODUCTS CO.
340 W. REDONDO BLVD., INGLEWOOD, CALIFORNIA

MARMAN clamps

Car to the Airport

(*Continued from page 76*)

taxi is expected to pay the amount indicated on the meter the instant it is pulled, even if that passenger only rode a few feet. However, it would not be fair to cite such a situation, because Boston's airport-to-city fare is predetermined and fixed, exactly like that at the great majority of cities throughout the country.

Also, Boston is not the only city so close to its airport. Rochester, Minn., is just 1½ miles from its airport and the fare there is 45 cents, which comes to 30 cents a mile. San Diego also is just 1½ miles from its airport and its cab fare is 50 cents (33.2 cents per mile) which, although it is higher than that charged in Rochester, is a good deal lower than Boston's.

Another mystifying phase of this airport-to-city transportation involves elapsed time. For example, that 75 cent one-mile trip from the Boston airport is scheduled as a 35-minute ride; contrast this with the 11-mile trip to the Youngstown, O., airport, scheduled as a 20-minute run.

In several instances, slight variations in mileage as listed by competing airlines indicates different city terminals, but on the whole the averages as mentioned above are those regularly posted for the air traveler who has flown speedily and luxuriously cross-country at 5.5 per mile —and with his meals included!

The operators of airport-urban services, on the other hand, complain that costs attendant on their operations warrant no comparison with those of the airplane. They point out that the seat cost per passenger-mile is but a fraction of the total revenue of the aircraft, the latter including revenues from mail and express, which revenues are higher than the passenger gross.

In addition, they complain, their operations are set up in accord with the demands of the airline passenger. These demands include efficient handling of all baggage, the best available equipment and a costly system of high-speed dispatching. Their passenger loads, even in the larger terminals, average only 62½ per cent capacity.

One operator points out that of his total revenue 24½ per cent to 38½ per cent goes for taxes, such as corporate and gasoline taxes, state and municipal franchise fees, social security taxes on personnel, Federal auto-use taxes, public liability costs, insurance up to $300,000 per accident, and baggage handling expense. This in addition to the maintenance cost of more than 32 per cent of revenue on his equipment, which, he says, cost more than $8,500 per vehicle.

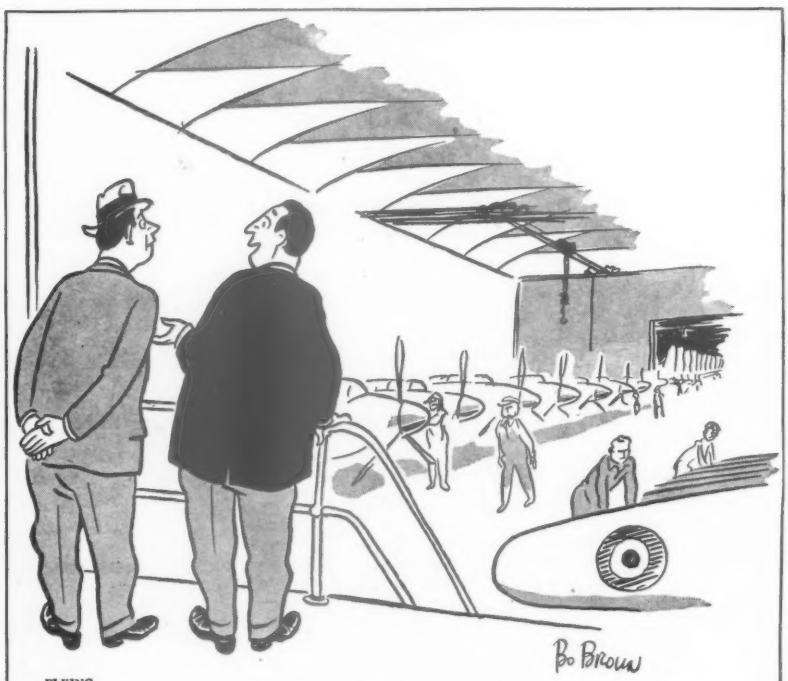
In the smaller cities it is pointed out that many of the operators have pioneered the services at the express request of the airlines themselves and at much expense. These operators are forced by the limited traffic in wartime to maintain a complete setup. Among their woes are cancelled air operations, which often run as high as 25 per cent of the working time and during which they have no other use to which to put the equipment or personnel, long waits between scheduled flights and the constant fight with ordinary means of transit such as taxicabs and buses.

From the point of view of the airlines themselves, one vice president says that the time is not far distant when the city terminal will be a thing of the past. Airplane tickets will be sold between field and field and it will be up to the passenger to get to the terminal just as one does to a railway station. The original scheme of doing everything possible for the customer, even at a tremendous cost to the operating divisions, both airline and auxiliary, was a necessary evil undertaken to promote and sell air transportation to the general public. Now, he adds, with the public in full knowledge of the time saved on flights even as short as 250 miles, such a system will cut the intercity times throughout the nation even more than under the present system of assembling the plane-load some distance from the point of enplaning.

Still another cab operator, who recently completed a survey of the country at the request of the airlines, says that of the original group who enlisted in the airport-city transit system only a few are left, the others having long since gone to the limbo of bankrupts who suffer in any pioneering venture. The promises of a growing industry such as aviation to produce a future volume commensurate with the investment has, no doubt, been somewhat postponed by the war, but even with full loads of passengers with full priority rights no such revenues as might normally be expected have been forthcoming. The limited amount of equipment on the airlines, the uncertainty of priority rights and other exigencies have all intervened to increase the temperatures and tempers of the airline bus operators, he added.

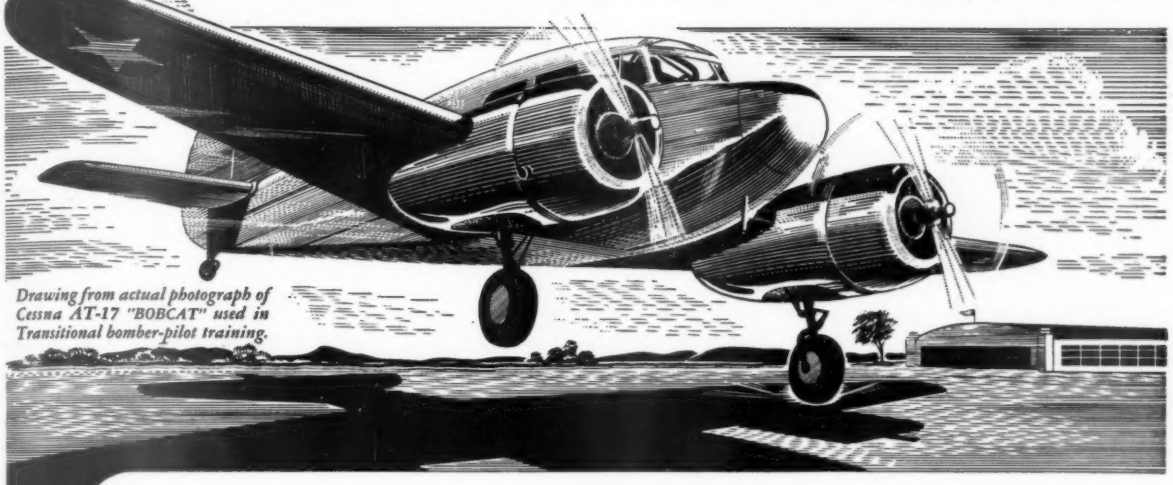
In a final blast a third operator exclaimed that the present services offer more per mile at less cost than is commonly supposed. He says that since the start of the war his traffic has gone down 50 per cent while his costs have risen. In these operations he has been forced to compete with taxicab and bus operators who are not perforce required to meet his conditions. He says these include allowances for road failures, the necessity for catching the waiting airplane in time to meet the post office requirements for mail revenues, and the uncertainty of the load volume for each trip, which often necessitates keeping two limousines on hand when only one is filled or partly filled. In conclusion he adds, "the security of connection, vital to the important priority passenger, far exceeds any economic details of the operation by other means of transit, the differences being nil in the long run."

END



"We send one-third to England, one-third to Russia and the rest to Warner Brothers."

THIS BOBCAT HAS 9 LIVES, TOO!



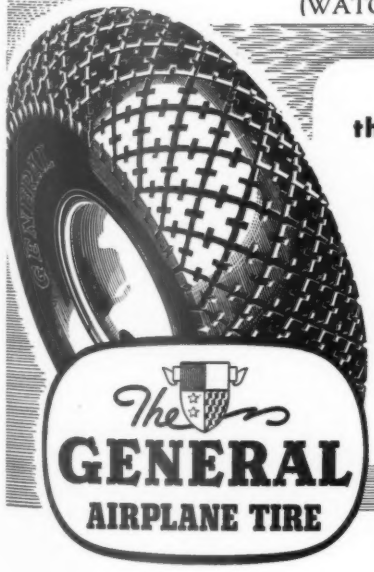
Drawing from actual photograph of Cessna AT-17 "BOBCAT" used in Transitional bomber-pilot training.

. . . thanks to TIRES that are Safety-Engineered

★ Like the furry creature whose name it bears . . . the "pads on the paws" of the CESSNA AT-17 *Bobcat* must be tough but resilient, must help absorb shock. For transitional bomber-pilot training in these fast, twin-engine advanced trainers carries its share of bouncy, wheel landings. So landing and takeoff safety in the Bobcat depends to a greater than average degree on *tires that can take it!*

And General Airplane Tires, backed by one of the longest records of practical aviation tire experience, are *proving* they can take it on every type of aircraft. You'll find General's *ahead-of-the-field* design on many types of trainers, heavy bombers, fast fighters...even on light ships in CAP! Too, you'll find top-quality Generals operating on carrier decks...on Alaskan ice and hot African sands. *Yes! Flyers everywhere depend on Generals!*

(WATCH GENERAL FOR AIRPLANE TIRE DESIGN TREND)



The GENERAL AIRPLANE TIRE

Here's Why General Has Won the Preferred Acceptance of Those Who Fly . . .

1. Built to Military and CAA specifications by experienced airplane tire engineers.

2. General's Rayon Cord means less weight, greater payload. More strength, resistance to impact and heat!

3. Dangerous static electricity, built up in flight, is grounded out the moment a General touches the ground . . . thanks to General's special electro-conductive construction.

4. There's a QUALITY General for every type of ship.

5. The same skill . . . craftsmanship and highest quality standards that have always characterized Generals are incorporated in the General Airplane Tire.

See Your Fixed Base Operator or Write—

THE GENERAL TIRE & RUBBER COMPANY

AVIATION DIVISION • AKRON, OHIO

KNOWN AROUND THE WORLD FOR QUALITY AND SAFETY

The Allison

(*Continued from page* 31)

aircraft designers were bending every effort to accelerate aircraft evolution. As the Army-approved power plant for single-engined pursuit planes, the Allison had to set a new epoch of design. In the past, the development of a new power plant always had evoked scores of new designs; but before new pursuit planes could be designed around the Allison engine it had to be perfected as the best of its type.

The trend was toward more horsepower and altitude, as designers in every country were drawing plans for air supremacy.

In 1937, an Allison engine was installed in the Curtiss XP-37. This plane, originally designed to take a radial engine, was changed in the nose for an improvised installation of an in-line type, and the aerodynamic features of the Allison, therefore, did not show up to full advantage. For the first time, in this experimental plane, a high-powered engine in combination with a turbosupercharger was flown.

The "D" engine, with a five-foot extended drive shaft, was developed for pusher-propulsion of the two-engined *Airacuda*, designed by the Bell Aircraft Corporation.

These early flight installations gave Allison engineers and the Air Corps valuable advanced data. Although the turbo-supercharged Allison "C" engine combination was an important step forward, it was decided to take an intermediate step —the building in of internal first-stage supercharging in the engine.

A conversion of the sea level "C" engine to an altitude rated model, known as the V-1710-C13, was installed in the Curtiss XP-40 in the fall of 1938. During flight tests, internal first-stage supercharger improvements were made. A combination was found that was very effective. The XP-40 won the Air Corps pursuit competition in the spring of 1939. This event was open to all aircraft developers, and the Curtiss XP-40 was the first liquid-cooled entry in years. Significantly, it tripled the annual speed increase of 10 to 15 m.p.h., set by a succession of previous air-cooled winners.

The Allison V-1710-C15, an altitude rated 1,090 h.p. engine, was the production model when the Army in May, 1939, issued its first quantity order. It was the 14th model of 20 engines, custom-built by hand, part by part, during the eight-year development period.

One month before receiving the Army quantity order, two months before the declaration of war in Europe, General Motors had broken ground for 390,000 square feet of factory, office and testing space. The concept of the Allison production schedule, with each succeeding Axis aggression in Europe, was revised upward by the Army until now there are several million square feet of plant space devoted to Allison engine production. The new Allison plant was planned without windows and with other features which later came to be called "blackout."

The problem of putting a custom-built precision engine into mass production presented many challenges: The Allison contains roughly 7,000 pieces; rough castings and blanks were to be analyzed before acceptance, inspected individually after each machining process, and after test of the engine (one-fifth of all Allison employees are classified as inspectors); all highly-stressed steel parts (like crankshafts and rods) and all rotating and reciprocating parts were to be magnafluxed both before and after machining; the engine called for 62 different specifications of metal, all of which would soon be high on the OPM list of critical metals; many parts required precision machining of the highest standard known—involute gear profiles and some splines were to be machined to .0001 inch tolerance, crankshaft parts and main journals to .0005 inch.

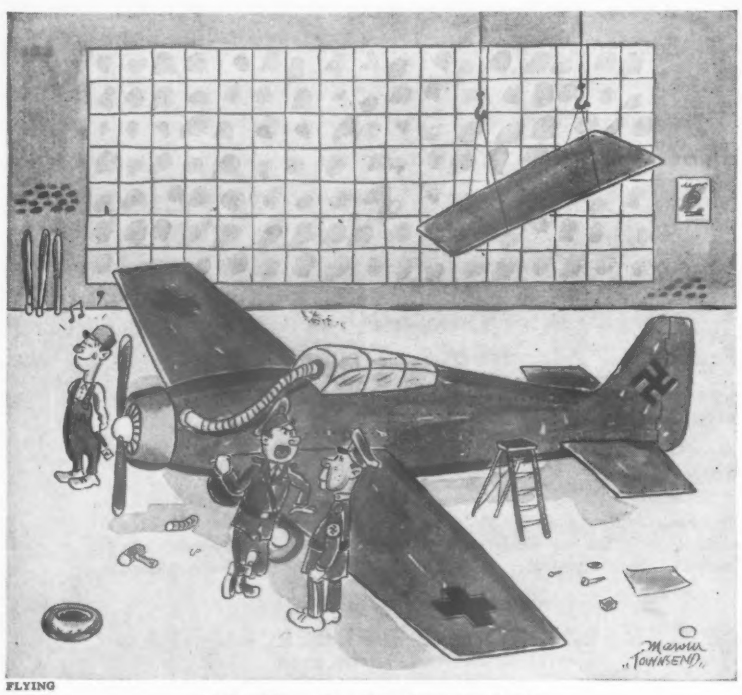
F. C. Kroeger, general manager of the Delco-Remy division of General Motors, became general manager of the Allison plant, and tooled it to build aircraft engines on something not much like an automobile assembly line, yet with the same principle of "flow" toward completion. Training personnel was the job of O. T. Kreusser, who had succeeded Gilman as head of the Allison organization. His "faculty" was the nucleus of 400 or more oldtime Allison master mechanics who had custom-built the 20 different engines of the eight-year development period.

The gravest Allison personnel problem —and other manufacturers have suffered similarly—arises from the excellence of the plant training and the defense migratory worker situation. Many of the employees have lived in Indianapolis "on the hook." As soon as they heard of a plant opening nearer their home towns, they had been prone to leave. At an 11,000-worker level, Allison had a turnover of 170 men a month.

As Allison tooled up and trained personnel, management and workers developed new manufacturing techniques. The hand micrometer, long regarded as the symbol of precision work, was not sensitive enough to check the closest limits to which parts had to be machined. New automatic gauges had to be devised. Available materials were adapted wherever possible, but recent metallurgical research was heavily drawn upon for new methods of processing and heat treatment. Shot blasting was adopted to toughen the skin of stressed steel parts. Nitriding, it was discovered, gave greater strength to the crankshaft, which with the same weight had to turn over 10 times the power of a fine auto crankshaft.

Subcontracting was a natural automobile solution to the problem of obtaining a flow of raw, semi-finished and finished parts. GM managers knew, from past experience, the manufacturing facilities of hundreds of potential suppliers. Other divisions of General Motors took assignments from Allison.

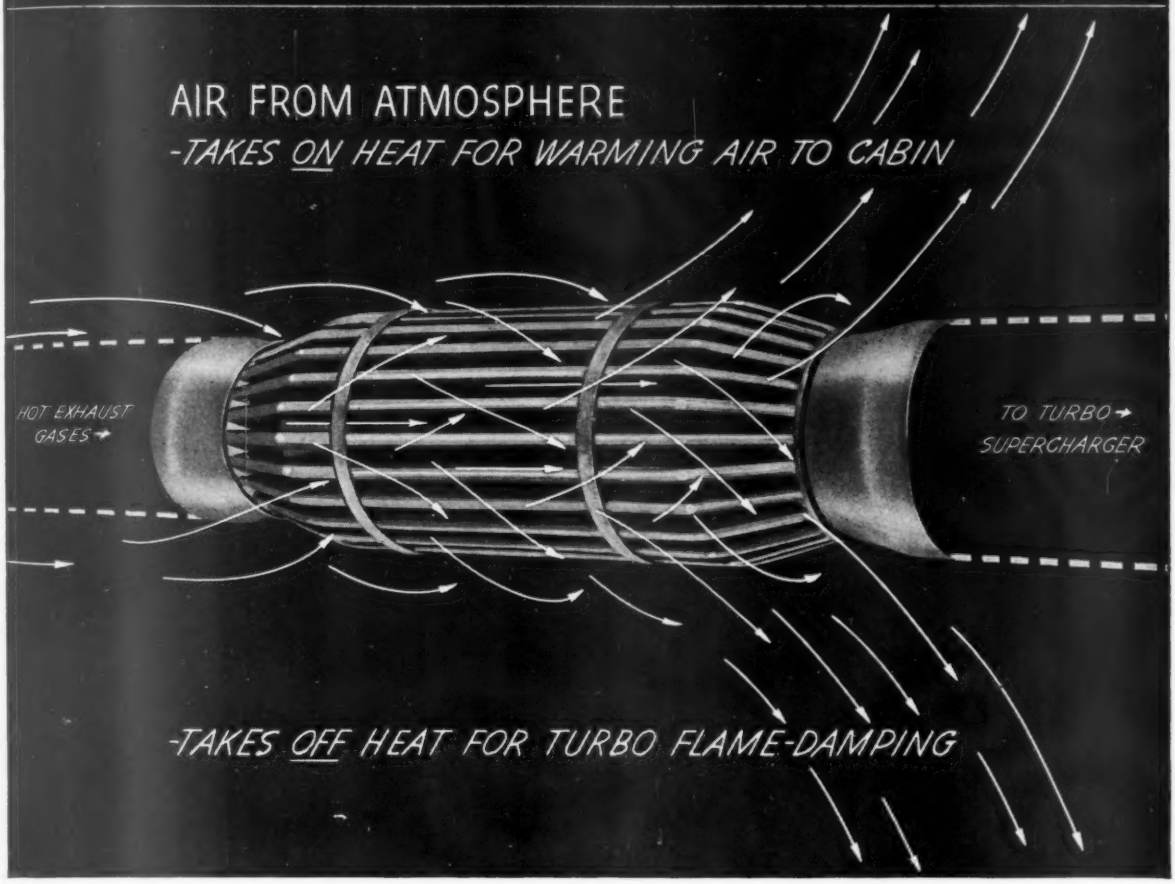
(*Continued on page* 86)



FLYING

"Ach! These French workers are stupid. He says running the exhaust pipe into the cockpit will produce the desired results!"

With this new Exhaust Heat Exchanger...


AIR FROM ATMOSPHERE
-TAKES ON HEAT FOR WARMING AIR TO CABIN
HOT EXHAUST GASES
TO TURBO SUPERCHARGER
-TAKES OFF HEAT FOR TURBO FLAME-DAMPING

AiResearch engineering provides *two more advantages* for U.S. aircraft.

"Put controlled air to doing new jobs *... find ways to make it do old jobs better."* This is a special year 'round assignment for one group of AiResearch engineers. And their most recent answer to the challenge is the AiResearch Exhaust Heat Exchanger.

Made of corrosion-resistant steel and simple in design, this new lightweight unit weighs but a fraction more than the section of exhaust pipe it replaces. It is complete in itself, requires no auxiliary equipment. And operates *with little or no drain on engine power* because back pressure is nominal.

To U.S. airplanes, the AiResearch Exhaust Heat Exchanger offers such advantages as these:

Simplified method of Cabin Heating. Heated air is ducted from Exchanger through an "interheater"—thus it warms counter-passing air to cabin, without danger of carbon monoxide contamination.

Power-conserving Flame-damping. Thanks to its low back-pressure, the AiResearch Exhaust Heat Exchanger can be kept in constant use for cooling turbo-operating exhaust gases. *With practically no loss of engine power!*

This new AiResearch development is now available to all U.S. aircraft manufacturers. Plus the assistance of AiResearch engineers in solving air, temperature and pressure control problems for specific aircraft designs. Inquiries are invited.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES, CALIFORNIA
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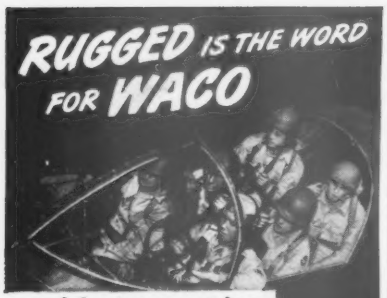
"Where Controlled Air Does The Job" • Automatic Exit Flap Control Systems • Engine Oil Cooling Systems • Supercharger Aftercooling Systems • Engine Coolant Systems

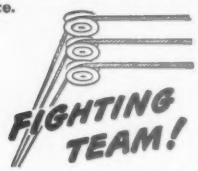


—and for troop-carrying gliders designed by Waco Engineers

GLIDER MANUFACTURE was nothing new to Waco Aircraft Company when our Army back in 1941 requested design and fabrication of two experimental glider models. But the size of the gliders our Army wanted was enough to stagger civilian imagination. One was to be capable of carrying nine well equipped men! The other, *fifteen!*

Waco engineers were not staggered, however — and the two gliders were delivered and approved in less than seven months! So thoroughly approved, in fact, that Waco was asked to produce all of these units its full capacity would allow. And other leading aircraft manufacturers too were soon fabricating these aerial assault boats under Waco's guidance.

America can be proud that she possesses engineers like Waco's — men who refuse to turn down a challenge, however tough the job it entails. Proud too of the Waco workers who are turning out these offensive weapons, of the subcontractors who are fabricating parts and sub-assemblies under Waco's direction...That pride can hold up well into the future, for these transport gliders promise much for the skies of Peace.



No extra spurt of power from roaring engines to pull a glider out of trouble! This kind of ship you control by touch—or else! That means the best there is in controls. Control cables are just as important on other airplanes too — and Roebling makes them *always* with that "best there is" in mind. John A. Roebling's Sons Company, Trenton, New Jersey. Branches and Warehouses in Principal Cities.

NAMES the U. S. must never forget

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McDONNELL
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NORTHROP
PIPER
REPUBLIC
RYAN
STEARMAN
TAYLORCRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
VULTEE
★ WACO

In these frequent messages, Roebling salutes each member of the aircraft industry in turn.

ROEBLING

means Control in the air

(Continued from page 84)

The Cadillac and Delco-Remy divisions made the major contribution. Cadillac makes 250 Allison parts, including crankshafts, connecting rods and gear-reduction assemblies. Delco-Remy furnishes aluminum and magnesium castings, in addition to 75 different machined parts. For Allison production, Delco-Remy has added two specially constructed plants.

Other GM divisions subcontracting Allison parts are Chevrolet, New Departure, Hyatt Bearing, Delco Products, Packard Electric, A.C. Spark Plug, Antioch Foundry, Harrison and Inland. Outside the corporation, 93 suppliers of raw materials, semi-finished and finished parts were enrolled.

Today only 20 per cent of parts (the most intricate) have to be machined at the Allison plant. The remaining 80 per cent flow into the plant from 60 different cities, scattered from Iowa to Connecticut.

By May, 1940, the new Allison plant began turning out engines on a production basis. During the latter part of 1939, the laboratory, in three months, custom built almost twice as many engines as had been built during the entire eight-year development period. Production, during 1940 and 1941, was stepped up as the Allison was specified as power for new Army pursuit planes. The goal of peak production, scheduled just 12 months before, was reached in December, 1941.

The attainment would have been impossible without the closest co-operation between the aircraft and automobile industries and the Air Forces. The mass production ideas of the automobile industry were reconciled to the precision requirements of the aircraft industry, applying the American mechanical principle of simplification, which made the sewing machine and the automobile mass products, to the intricate mechanism of the Allison engine.

What makes the Allison engine as American as ham and eggs is one important point of difference with comparable European liquid-cooled engines. The 7,000 parts of the Allison engine comprise only 700 "piece parts"—or separate production problems—as against 2,300 "piece parts" in the most widely-known European rival engine. For example, piece parts in one small sub-assembly were reduced from 38 to 3 simply by casting the part whole rather than bolting it together. Incidentally, this resulted in a part that could be machined with greater accuracy for durability.

The implications of Allison's record 700 piece parts are important—the Allison is easier to maintain than a European engine with three times as many parts. Reduction of overhaul periods means more fighting hours for a squadron of fighting ships, more economy in maintenance. The number of actual fighting hours that can be wrung out of a squadron may well overcome a numerical disadvantage.

Putting the Allison engine into production did not mean that it was frozen there. Power output of the engine was first increased from 1,090 to 1,150 h.p. early in 1940. Usually model change means complete shutdown of production for necessary retooling, but Allison managed to maintain at least 60 per cent of its productive output during the switch-over.

The "C" engine powered the Curtiss P-40, and the "E" engine was developed for the Bell *Airacobra*. Design called for development of a 10-foot extension drive shaft. Engineers in Europe had tried and dropped the idea, and Allison engineers approached the problem with trepidation. Torsional analysis gave the extension shaft good characteristics through the range normally checked, but at low speed terrific vibrations developed that broke down a flexible shaft at the rear of the engine. The solution, which might have occurred to any automobile engineer, was a simple hydraulic damper application—in effect, a shock absorber that cushioned rebound in any direction.

Another Allison feature is the symmetrical crankshaft, which makes right- or left-hand rotation optional on current models. This gives the twin-engined Lockheed *Lightning*, in the American version, counter-rotating propellers. Equipped with turbosuperchargers, the *Lightning*, with its present total of 2,300 h.p., climbs rapidly to high altitude.

The "F" model recently was designed to give Allison higher horsepower output. It is 30 pounds lighter, with 10 per cent less frontal area, and is 10 inches shorter than the "C" model, due to a redesigned reduction gear. In June, 1941, the "F" passed a successful 150-hour type test at a 1,325 h.p. altitude rating. This represents an increase in power of 175 h.p., the equivalent to the power of two small motor cars, attained without major redesign of the engine.

Thus, since the 1,090 h.p. engine passed the 150-hour type approval test Allison engineers have increased power output by more than 20 per cent and they confidently expect this process to continue.

The "F" engine now is furnished in several models, right- or left-hand rotation, sea level or altitude supercharging, and various power ratings from 1,150 to 1,325 h.p. Production several months ago was changed over from one model of the "C" type to four models of the "E" and "F." The first month of the changeover, "E" and "F" production fell only one-third below peak "C" production, and the second month exceeded that level. Production since has risen steadily.

That, considerably telescoped, is the chronology of Allison engine development and its adoption by the Army for pursuit-plane power. Obviously, those pursuit planes are not identical, or even similar. What are some of the matters affecting decisions as to what type of engine—what type of Allison engine—to use in fighter aircraft?

First, there is the point that by this time should be obvious to everyone, but is still too frequently ignored in loosely-phrased comparisons of fighter types: fighter aircraft have various missions to perform, some requiring planes that can fight well at high altitudes, some at medium altitudes and others close to the ground.

It is doubtful that designers ever will be able to turn out a completely satisfactory all-purpose fighter. Certainly at the present stage of aeronautical development it is impossible to design one

Pied Piper of the Pacific

Getting rid of rats takes on a new distinction as the rest of the world moves to overpower Axis treachery. And nowhere is a better job being done of it than by the gallant members of the U. S. Army Air Forces. For heroism in the southwest Pacific this announcement of the award of the Silver Star to Lt. Clifton H. Troxell comes from General MacArthur's Headquarters, Australia, October 16th:

...alia. ... attended ... School and Case School of ...ied Science, was cited for gallantry over New Guinea.

Piloting an Airacobra fighter, he downed one Jap Zero and scattered others which attacked transports he was escorting. After breaking up the numerically superior enemy formation he continued his patrol.

With the devastating fire power of his cannon bearing P-39 Airacobra, this modern Pied Piper of the air destroys the rats which threatened to overrun civilization.

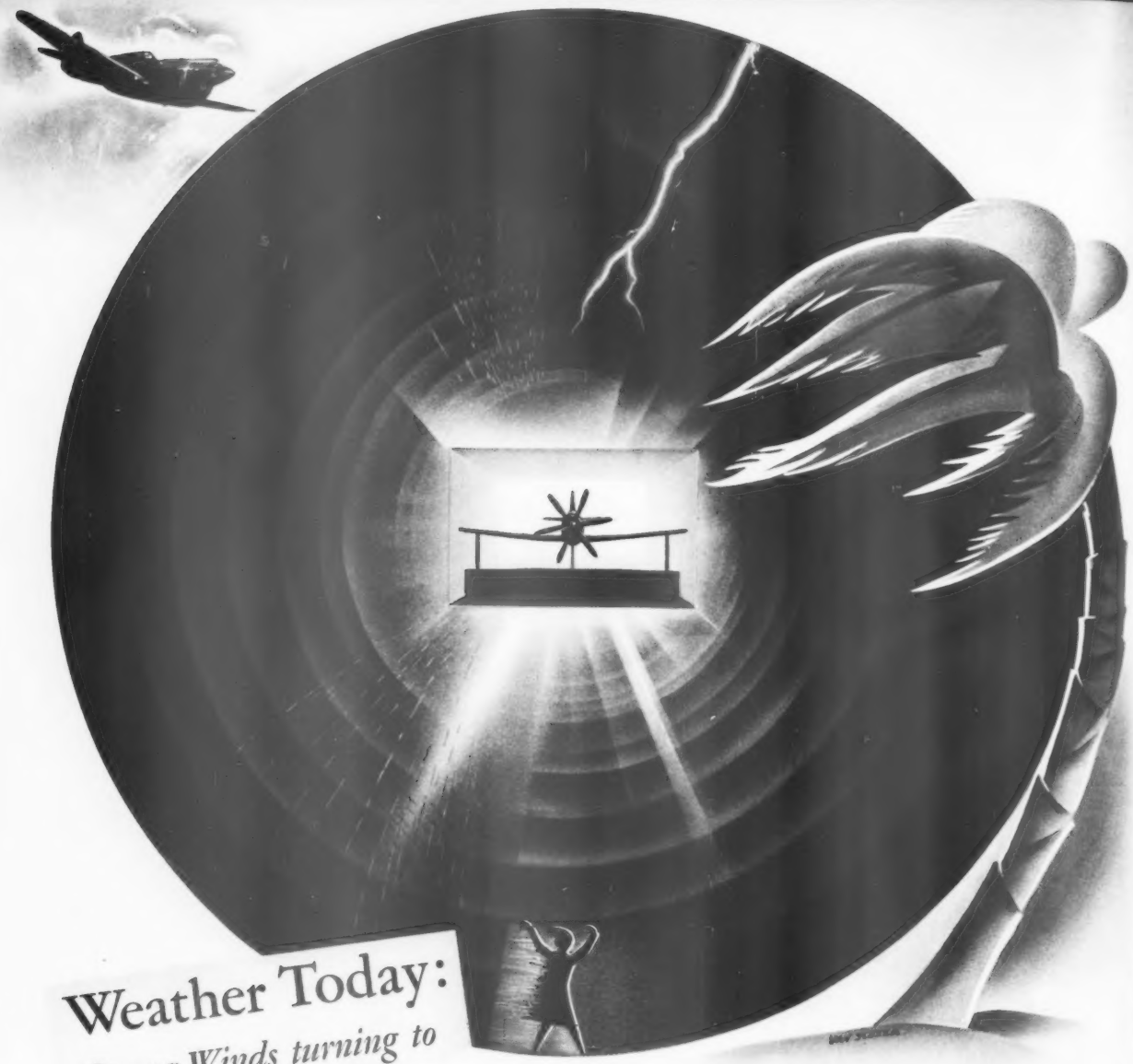
When the rats are gone, he'll come back to a world in which the technical advances that war has brought to Aviation will be put to even greater use. We, at Bell Aircraft, will have the engineering ability, the means of production and —most important—the tradition of Aviation pioneering to play our part in that coming era. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—

FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

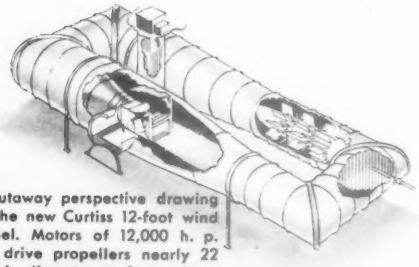


Weather Today:

Strong Winds turning to

HURRICANE

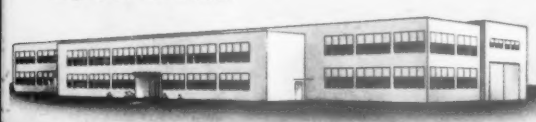
(if required)



A cutaway perspective drawing of the new Curtiss 12-foot wind tunnel. Motors of 12,000 h. p. will drive propellers nearly 22 feet in diameter to force air at high velocity through a testing "throat" where instruments will record the flying characteristics of large-scale test models.

● Hurricane? No hurricane of record even could approach the 700-mile-an-hour man-made tempest which will be turned on and off at will in the new Curtiss wind tunnel. One of the world's two largest, it is but part of the modern equipment in the new Curtiss Research Laboratory where all of the complex phases of tomorrow's aviation will be explored.

Here is impressive evidence that the aviation industry is looking ahead to the skies of the future—to a not far-distant day when giant passenger liners ... huge cargo carriers ... luxurious private craft ... fighters, bombers, battleships of the air ... will fly at altitudes and speeds eclipsing anything that the world knows today.



CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

plane that will have the maximum of all requirements for superiority in every mission. Although it is quite possible to supply an *engine* that is effective at all altitudes, the size, weight and complications necessary to accomplish this offset the advantages in horsepower gain when the aircraft operates in the lower altitudes.

Global warfare involves operations in a wide variety of climatic and tactical conditions, and the United States must have a complete line of planes—low altitude fighters for attack, high altitude for defense and escort. And they must fly in heat or cold, dust or damp.

The basic engines can be the same in all these planes, but the complete power plants will differ because it is necessary to vary such auxiliaries as supercharging to make the power plant most effective at the altitude for which the plane was designed. The engine is the power-package delivered to the plane designer. He can use it to fly high or low, to carry more weight, to gain speed, increase the rate of climb, or do other things. But the designer has to make a choice, to reach a compromise. Using one advantage means sacrificing another—even an airplane designer cannot "eat his cake and have it, too."

Military planes are highly specialized aircraft, and the specifications for their design are based on the kind of work they are expected to do. This sets up marked differences, not only the obvious ones such as between bombers and fighters, but as between models within the same general category. For instance, Britain produces heavy bombers operating at night at low or medium altitudes for large-scale area-bombing, while the United States builds high-altitude heavy bombers for daylight precision bombing of smaller but specific objectives. Similarly, there are many different kinds of fighters—more or less heavily armed, with more or less armor, more or less cruising range, with optimum performance in speed, climb and maneuverability at low levels or high altitudes.

Planes of many different types and having varying aerodynamic characteristics may be built around a given basic aircraft engine and will have widely varying performance characteristics. So it becomes obvious that the engine alone does not determine the performance characteristics of any given plane.

Basic aircraft engines are evaluated largely on the following factors: (1) horsepower/weight ratio—the weight of the engine in relation to its horsepower capacity; (2) horsepower per cubic inch of displacement—a secondary measure of the power/weight ratio, but commonly discussed in evaluating engine design since the size of an engine, or the dimensions within which it may be installed, is important in the plane design; (3) frontal area—the area within which an engine may be streamlined in its installation (affects wind resistance or drag; the effect of engine auxiliaries on drag must also be included in this evaluation); (4) fuel consumption — measured in pounds of fuel consumed per horsepower per hour, and varying from 0.4 pounds to 1.2 pounds per horsepower per hour.

Following this evaluation of the basic engine comes a similar consideration of auxiliary equipment, the principal auxiliary being the supercharger.

It takes about 14 pounds of air mixed with a pound of gasoline for so-called complete combustion of aircraft engine fuel, and the amount of power which can be obtained is directly proportional to the amount of air it is possible to get into the cylinders. The conventional unsupercharged engine depends upon the atmospheric pressure to push the air into the engine, but air pressure decreases as the plane climbs higher, and the pressure available to push the air into the engine drops correspondingly. Furthermore, as the atmospheric pressure drops, so does the weight of air in a given volume.

With the effect of temperature change and back pressure the engine could deliver more power to the crankshaft at increasing altitude if the same weight of air could be gotten into the cylinders, mixed with the proper proportion of fuel. To do this, a supercharger is used. This is simply a centrifugal fan type of air pump running at very high speed, which must take enough air at the lower density of the higher altitude and force it into the engine at the same rate (measured

FROM CASABLANCA TO NEW GUINEA
and on every United Nations Front a job is being done by
PIONEER PARACHUTES
Partners in Victory! As a sailor depends on his ship, the pilot his plane, so the paratrooper depends on his parachute. Pioneer Parachute Company's ceaseless research, scientific testing and coordination of production combine to give the United Nations the most dependable parachutes ever devised.
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in weight) as the engine receives air at sea level.

Aircraft power plant designers in this country can make available many variations in methods of supercharging, each with its particular advantages. Of these, eight stand out as having important differences: (1) sea level; (2) single speed, single stage; (3) two speed-single stage, mechanical clutch; (4) variable speed, single stage, hydraulic clutch; (5) two stage with mechanical clutch; (6) two stage with hydraulic clutch; (7) two stage with hydraulic clutch and intercooling, and (8) turbosupercharger with intercooling. (For a more complete discussion of supercharging, see "Engines and Altitude," by Rex Sydney, in FLYING, March 1943.—ED.)

Knowledge of these various types of supercharging make it obvious how many different possibilities there are in the *same basic engine*. The sea-level engine, useful in a ground attack plane with no altitude performance, when fitted with the turbosupercharger and intercoolers becomes a first-rate high altitude engine. With careful attention to interchangeability, the engine for every one of these combinations can be made to come off the same production line with only a few modifications at the rear of the engine.

Variations in horsepower-altitude performance are obtainable, then, by various methods of supercharging—variations which are partly engine modifications and partly items entirely separate from the engine. Moreover, the weight, size and characteristics of the plane actually affect the overall airplane performance to at least as great a degree as power plant modifications. And in every case, while more supercharging results in better high altitude performance by the engine it also results in increasing complication, weight and frequently drag.

Dive bombers, torpedo bombers and aircraft specifically designed for co-operation with ground troops do not require engines supercharged for operation at high altitudes and are more efficient without such equipment.

High-altitude bombers, bomber escorts and interceptors are types of ships requiring maximum performance at high altitudes. High altitude supercharging must be provided regardless of the detrimental effect on low altitude performance.

Intercooling or aftercooling—lowering the temperature of the air-fuel mixture—introduces a new set of problems in power plant and plane design almost equal to those created by the addition of supercharging itself. Then why any cooling?

Compression raises the temperature of air. Supercharging is compression of air, and a higher degree of compression is necessary as air density thins out with rise in altitude, but—the more compression the higher the temperature of the compressed air. When a given grade of fuel is used, the higher the temperature the nearer the approach of either pre-ignition or detonation.

There is a point in supercharging where this danger of pre-ignition or detonation, or both, occurs. When the requirements of supercharging to get high horsepower at high altitude reach this point it becomes economical to introduce intercooling despite the added weight and size of equipment and the drag of the added cooling radiators.

Looking farther into this matter of comparing fighter planes, another stumbling block attracts attention: failure to understand that *critical altitude* and *service ceiling* are two distinctly different things. Critical altitude of a *power plant*, determined by the engine and its supercharging equipment, is the altitude at which *maximum* power output of the engine begins to fall off directly with altitude. Critical altitude of an *airplane* is the altitude at which maximum speed in level flight is obtained. With a given basic engine the designers can, within certain limits, fix this critical altitude wherever they think it ought to be, all factors considered. Moreover, although the critical altitude of the plane is the important factor, it is not necessarily the same as the critical altitude of the power plant, and may be appreciably higher.

The service ceiling of an airplane, which varies with the weight of the fully equipped plane and its wing loading, as well as power, is the highest altitude at which it is practical to fly. Specifically, it usually is defined at the maximum altitude at which the plane can still maintain a rate of climb of 100 feet a minute.

There is a wide difference between the critical altitude and the service ceiling of any given plane, and the measure of superiority is neither speed nor altitude alone, but the performance at any altitude compared with the enemy's performance at the *same* altitude.

In summation, the limitations upon power plant design, particularly as to the installation of supercharging and intercooling, created by the requirements of plane design, are of high importance. And they are imposed, not so much by the abilities of the engine as by the tactical needs, the combat mission.

All these considerations—and of course many others—influenced the design of the American fighter planes using the Allison engine—*Tomahawk, Kittyhawk, Airacobra, Mustang, Lightning*. And just as their successes are not due solely to the Allison engine, neither are their deficiencies.

The principal deficiency of the *Tomahawk*, for instance, was inadequate firepower. The result was that comparatively few were produced, and the *Kittyhawk* came along quickly—basically the same, but with enough firepower to make it one of the deadliest fighters in the world. It is, to be sure, a medium altitude plane—and so is the *Warhawk*, latest of the P-40's, with a Rolls-Royce *Merlin*

FLYING "This unexpected situation, Corporal Morehouse, does not alter the fact that I am your superior officer! . . ."

Training Casts its SHADOW...

JACOBS AIRCRAFT Engines

This shadow is becoming a familiar one over Nazi-held Europe, and will become increasingly familiar.

The devastating accuracy that accompanies this shadow was born and developed on American Training Fields, where the Army Air Forces Training Command taught the pilots and crews to concentrate on the accomplishment of their mission with *precision*.

Complete reliability of Training Plane engines is essential for such concentration.

The majority of the twin-engined Training Planes, in which the Bomber Pilots are schooled, are powered by Jacobs. This reliable power enables them to concentrate completely on the precise bombing technique, without a thought to their engines. This same reliable power will also allow thousands of Americans to carry their families and friends through the air with complete security after Victory is won.

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and ENGINEERING that harnessed the "Mustang's" spirit and stamina for fast production, easy maintenance!

MEET THE "MUSTANG", wild horse of the air—and the staff of engineers who broke it to saddle. One of the fastest, fightin'est craft in the air today, this P-51 has galloped high, wide and handsome over everything thrown against it.

You don't get that speed and stamina in a plane by just thinking about it. You start with specified equipment and armament. If you're as good as North American's engineers, you come up with a mock-up in something under a month. That approved, you put in sixteen hours a day, seven days a week, for *one hundred* days—and the first experimental plane rolls out for testing, ahead of schedule.

Speed in design, in mass-production, in the air—from first to last, North American's "Mustang" stands for *speed*, a specific quality for its *specific wartime job*. You can be proud, America—and thankful—for the skill that brought this fighter plane to near-perfection in less than a year! With skill like that in your technicians' ranks, you can look forward to new miracles in the skies of Peace!

NAMES the U. S. must never forget

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Hundreds of parts help harness an airplane's horsepower. Just as there is no one plane that is "best", no one of these parts is "most important". Here at Roebling, though, we make aircraft control cable as if it were the *only* harness for horsepower on the plane. John A. Roebling's Sons Company, Trenton, New Jersey. Branches and Warehouses in Principal Cities.

JAR ROEBLING

**In these frequent messages, Roebling salutes each member of the aircraft industry in turn.*

ROEBLING

means Control in the air

engine in it. It is interesting to note in passing that the P-40, once most criticized of American fighters, is the only one which appears to have performed equally well in all combat theaters, under all conditions of climate. Such versatility, of course, could be obtained only at the sacrifice of various specialties which might have given it brilliant distinction in restricted zones. Compare the P-40's record with that of the *Spitfire*, for instance. The latter, incontestably the greatest of all fighters over Britain, was just a mediocre airplane in Burma, and definitely inferior to the P-40 in the peculiar conditions of the air fighting over Egypt and Libya.

The *Lightning* has been from its inception a high-altitude fighter, an interceptor of tremendous speed and extraordinary range as current production-model fighters go. It was a long time coming into quantity output, but the difficulties were not in its twin Allison engines. Now, in increasing numbers in Africa and the Pacific, it is proving itself one of the finest fighters in use.

The latest model of the *Mustang* also marks a shift from Allison to Rolls-Royce, and in this case the shift is accompanied by high-altitude performance. This North American plane was designed originally, however, as a ground support and attack fighter, and its Allison engine was part of the design which put it in the 400 m.p.h. class.

The *Airacobra*, with its Allison engine placed behind the pilot and at the center of gravity of the plane, is one of the most maneuverable of fighters. It is not as fast as the *Mustang* or the *Lightning*—but few planes are.

The matter of supercharging Allison engines has been widely discussed in public, with a multiplicity of conclusions. Well, they have been supercharged one way or another right along, but always with the idea that they could use *any* supercharger, depending only on the operational altitude desired.

Power output also has been a subject of considerable yammering in print, with the Allison generally low-rated as the least of the in-line engines. That simply is not true. The military rating of the Allison V-1710-C15 (later Allison model ratings are available, but not those of all the others) was 1,090 h.p. Military rating of other liquid-cooled engines of the corresponding model was: 1,000 h.p. for the Daimler Benz DB-601-A, 1,025 h.p. for the Rolls-Royce *Merlin X*, 1,100 for the Hispano-Suiza 12Y-51, and 975 h.p. for the Junkers *Jumo 211*.

As to the "built-in headwind" argument, the liquid-cooled protagonists pointed with glee to the fact that the Navy, with its *Corsair*, and the Army, with its Republic *Thunderbolt*, both powered with 2,000 h.p. radial air-cooled engines, had passed 400 m.p.h. with some to spare, it's true, but had been forced to add about 35 per cent more power to gain only about 10 per cent in speed. Superficially it looks like the liquid-cooled advocates had a point. Actually, of course, so many more factors than a snub-nose entered into the designs that, while the point might be indicative, it certainly was not conclusive. There are designers who insist that, with increasing size of planes, the streamlining advantage of in-line engines disappears at speeds above 400 m.p.h. But at higher speeds, a lot of other things begin to happen, too, such as the unhappy tendency of air to "shatter" instead of flowing past the streamlined form. Engineers are still seeking the answers to flight problems at speeds above 450 m.p.h., and the answer involves a lot more than settling the argument between air-cooled and liquid-cooled engine enthusiasts.

The Navy has stuck with the radial for many reasons, most of them having nothing to do with streamlining for additional speed. Stubnose ships have more lifting power, get off the carriers with shorter runs and land more slowly than do extremely streamlined types. The elaborate plumbing system of most liquid-cooled power plants is vulnerable in combat, entailing greater repairs—and a carrier must go to sea cluttered with the least possible amount of space-using machine shop.

There has seemed to be a tendency in some parts of the Army to design new planes around air-cooled radials rather than liquid-cooled in-line engines, possibly because the new planes are heavier and Allison and other manufacturers of liquid-cooled engines had not yet announced development of engines of 2,000 h.p. or better, as the manufacturers of air-cooled engines have done.

But Allison in a few short years of experiment and manufacture has upped the rating of its 12-cylinder V-1710 from 1,090 to 1,325 (it actually puts out quite a little more, and has an edge over the *Merlin*), and it can be flatly stated that the ultimate in liquid-cooled engines has *not* been achieved. As in the case of the British Napier *Sabre*, so in the case of Allison's proposed 2,000 h.p. engine, the scheme has not quite proved itself. The Napier *Sabre* is ahead—the new Hawker *Typhoon* is powered with it, and credited with a speed in excess of 400 m.p.h. The *Typhoon* first saw action over the Dieppe commando raid last fall, but it was mid-January before its use was announced publicly, and one of the reasons for holding up the news was that all the "bugs" had not been worked out—had not been, in fact, when the announcement finally was made.

Meantime, Allison engines have performed superbly in various types of planes on every front of the war, and will go right on powering fighter aircraft until the war is won—even if there were no further improvement at all.

END

Spanish CAP Unit

THE New Jersey wing of the Civil Air Patrol recently announced the planning of an all-Spanish speaking squadron, under the direction of state wing Public Relations Officer Joseph E. Wiedenmayer, open to Spanish speaking applicants over 17 years of age and citizens of the United States or South American countries in sympathy with our war objectives.

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With such a background of manufacturing experience, Romec was well prepared to play an important part in aviation progress. Progress that helps speed the day of victory.

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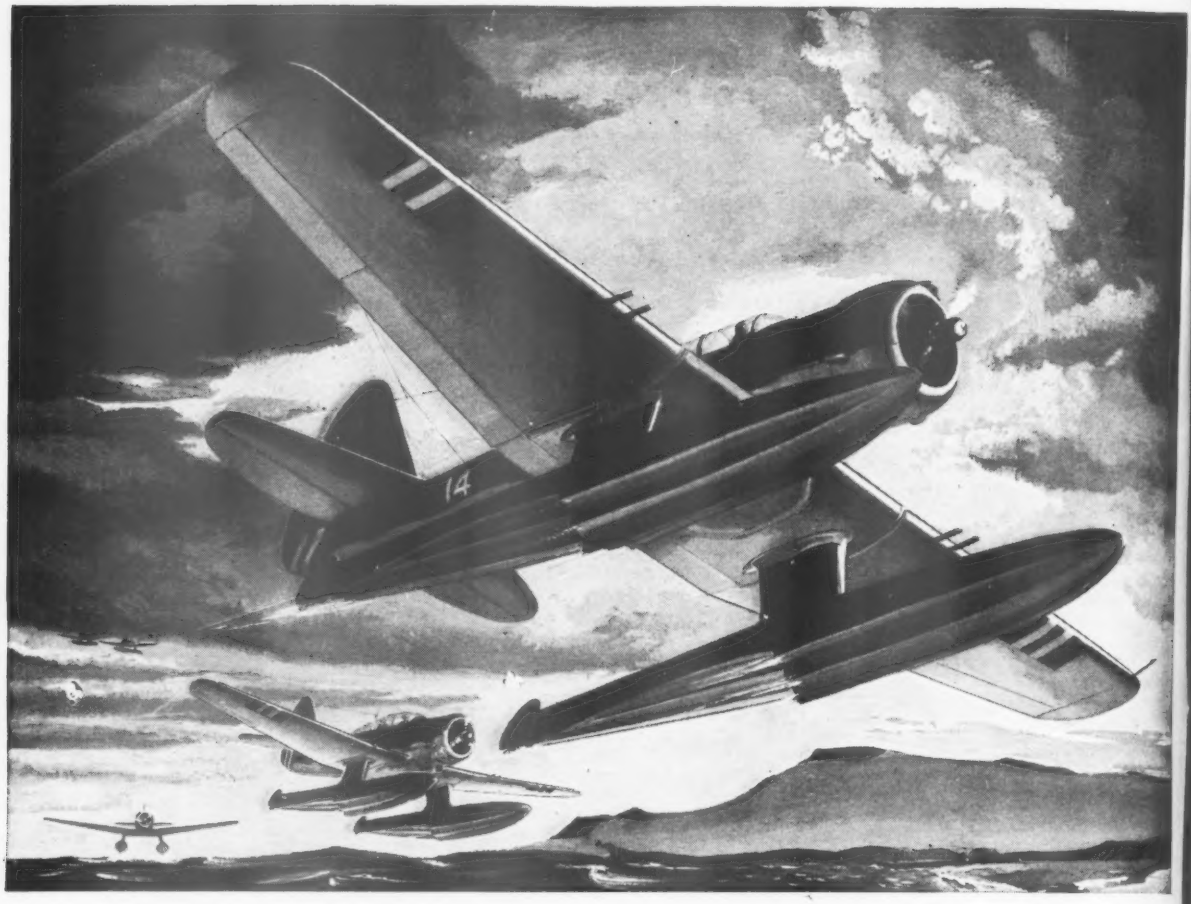


Norway's unconquerable warbirds

These are the deadly Northrop N3 Patrol Bombers with which the Royal Norwegian Naval Air Force for nearly two years has helped to hold the Nazis on our North Atlantic sea border

BY MID-JUNE IN 1940, the Nazis had overrun all of Norway. And we here at Northrop had just begun work on a new patrol bomber for the Royal Norwegian Naval Air Force.

Quit? Not those fighting-hearted Norse! Teaming up with the RAF, they established "Little Norway" in Canada; ordered us to rush completion of these Northrop N3-PB's for combat use in the Far North.

The job, from preliminary sketches to the first bomber off the line, took us exactly nine months and one day.

We're particularly proud of that record, for the N3-PB is a favorite with Northrop men and women. Not just because this hard-hitting bomber is the world's fastest military seaplane. Nor because she can pack 2000 pounds of bombs or a torpedo with equal grace. Nor is it because she can throw more lead than many a four-motored bomber. What pleases us more than any of these virtues is her STURDINESS.

Battered for nearly two long years by North Atlantic winds and waves and storms, with vast distances their everyday assignment, these swift petrels of Norway's Royal Navy have proved as tough as the Vikings' sons who fly them.

In battle, the Northrop N3 Patrol Bombers have shown their strength, too. They have sent to the bottom more than their share of U-boats. They are reputed to have taken part in the epic chase of the Bismarck. They have driven back giant German bombers.

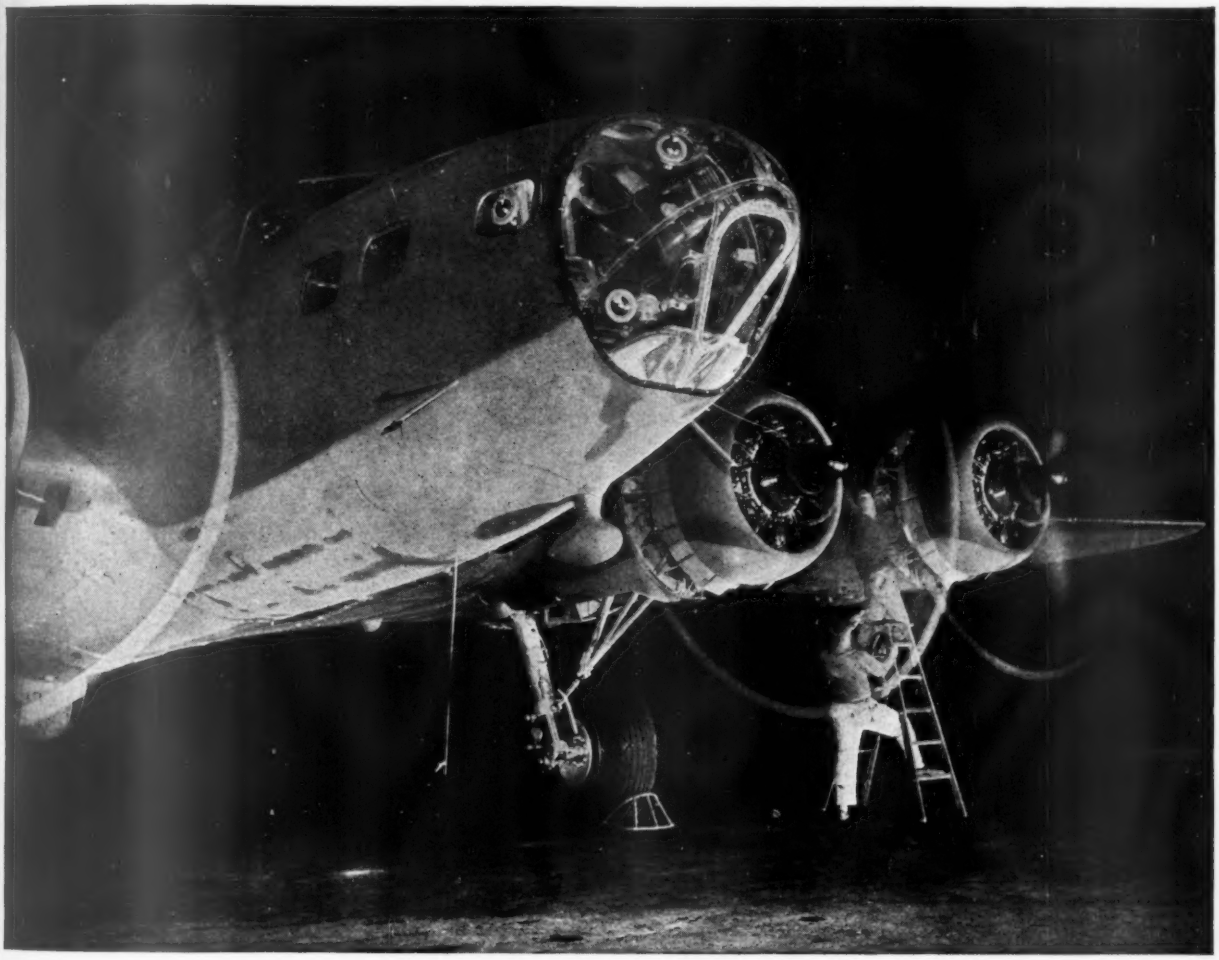
We hope you'll pardon a manufacturer's pride in relating all this to you, for the Northrop N3-PB is just one of a number of American-built warplanes that have helped to set the pattern for victory. *(You can help to shape this victory pattern more swiftly by buying War Bonds in increasing numbers.)*

NORTHROP AIRCRAFT, Inc.

NORTHROP FIELD, HAWTHORNE, CALIFORNIA • MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

Plexiglas

ON THE FLYING FORTRESS



A Boeing Flying Fortress, built by Vega, warming up at night

THE world's first transparent plastic bomber nose was made of PLEXIGLAS—in a Rohm & Haas plant. It was here that the method for mass production of these curved sections also was developed.

Today you'll find PLEXIGLAS aboard every type of Army and Navy airplane . . . in bomber nose assemblies, tail enclosures, gun turrets, cockpit covers . . . down to the smallest windows and landing light covers.

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PLEXIGLAS is the trade mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets and rods manufactured by the Rohm & Haas Company

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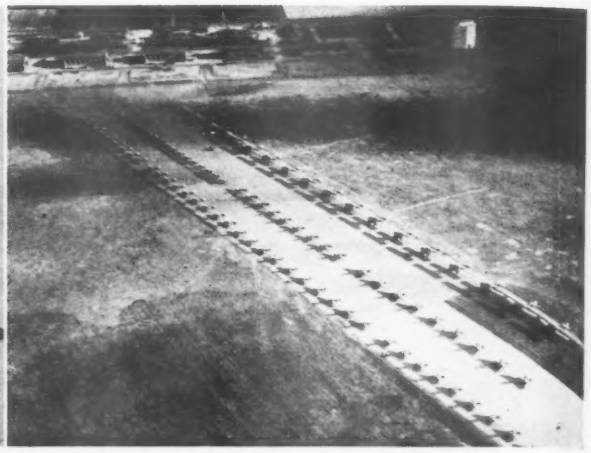
Air Services Section

Curtiss OX-5 "Jenny," mainstay of Kelly Field's earliest days, on which many World War I Army pilots were taught.



This lineup at Kelly Field included seven types, ranging from North American BT-9 to Keystone LB-2 in background.

KELLY FIELD BOWS TO PROGRESS

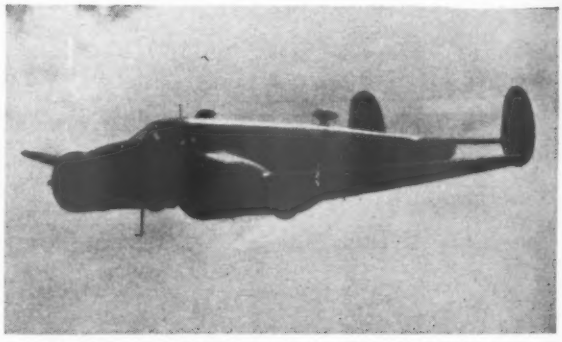
A PENNED signature on an Army order form ended the independent career of one of America's most famous training fields on March 1, as Kelly Field became "just another" in the string of Air Service Command airports. Famed since the early days of World War I as a pilot training center, Kelly has been merged with its stepson, Duncan Field.

First organized as Camp Kelly on June 11, 1917, the Texas site became Kelly Field on July 30 of that year. It was named for Lt. George E. M. Kelly, who died in a crack-up in 1911.

By the time of the Armistice, Kelly had spread into two fields. Kelly No. 1 (Duncan) and Kelly No. 2. One thousand seven hundred fifty-seven men had been presented their wings there as Army pilots and countless others had been schooled as mechanics, chauffeurs, engineers and flying instructors.

Following the war, all pursuit and bombardment training was transferred to Kelly and later, in 1922, observation training was sent there. In 1926, Kelly first lost its place in the lime-

(*Continued on page* 100)



Every form of flight training has been based at Kelly at one time or another. Last year, navigation was taught in AT-7's.

Late in 1942, when Kelly became a training center for instructors, these Vultee "Valiants" joined its fleet.

"O BRAVE NEW WORLD..."

The shortest distance between two points is . . . a curved line across the top of the world! Short cut sky lanes to Bombay, Chungking, Moscow, Tokio, Sydney, Cape Town rise high above vast seas of glittering, icy wastes. Sky lanes—now being charted by the post-war planners of America. Sky lanes that bring our very farthest neighbor to us in no more than 60 hours.

Tomorrow's new world lies in the palms of the draftsmen of today. They are linking country to country, continent to continent. And in this tremendous project, as in every other important blueprinting work, *Typhonite* ELDORADOS lead all other drawing pencils with their decisive clarity, uniform degrees, opacity and speed. *Typhonite* ELDORADOS are helping to plot our brave new world.

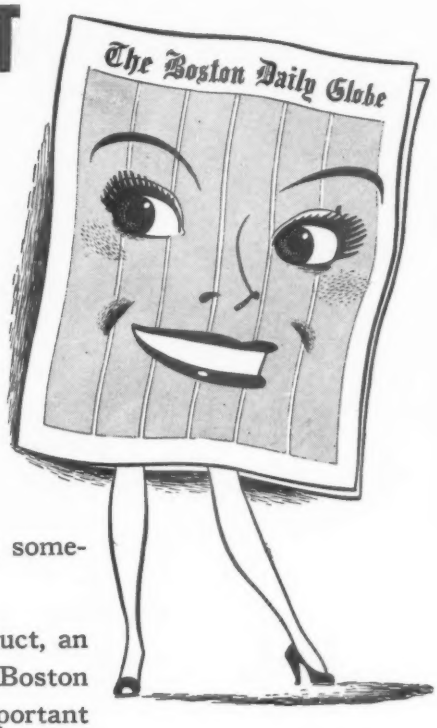
✣ ✣ ✣

**The new booklet describing the* Typhonite *process is offered to draftsmen. Write for your copy mentioning this publication.*

Pencil Sales Dept. **64-J5,** Joseph Dixon Crucible Company, Jersey City, N. J.

It's BLACK and WHITE and *really* read all over!

AND WE can PROVE IT



FOR L. M. Clark, Inc., set out a while ago to analyze newspaper readership of 23 standard-size newspapers in 11 top-flight American markets.

Two Boston newspapers were studied, 21 others in 10 other cities.

The Clark people, specialists in this sort of thing, took plenty of time and thousands of personal interviews to do the job.

When they got through, they really had something.*

And, if you're interested in selling a product, an idea or a name to the people of this rich Boston market, you'll want to see the results of this important readership study before making your final media selection.

Phone or write the office nearest you among those listed below for a copy of "Confessions of America's Most Exasperating Newspaper — According to the Research of L. M. Clark, Inc."

P. S. So had we. THE BOSTON GLOBE was first in Boston, first in the nation, in the two big indices of the Clark Studies — "Reader Traffic on Advertising Pages" and "Reader Observation per 100 Lines of Advertising."

The Boston Globe

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Your Advertising Story will be BETTER READ in the BEST READ Newspaper

Powerful Vega Venturas are blasting enemy-held territory in occupied Europe with increasing fury. Their great speed, range, and bomb loads are made possible by a pair of dependable 2,000-horsepower Double Wasps.

PRATT & WHITNEY AIRCRAFT

EAST HARTFORD, CONNECTICUT

ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

(Continued from page 96)

light as a flying school as it was then made the finishing or advanced flying school for the cadets from Randolph and California's March Field.

From time to time, Kelly Field has been assigned one job and another in the pilot training program. Navigators and air crews were assigned there when the field was used as a reception center. The last job assigned to the installation was as a school for Army Air Force instructors.

During the almost 26 years of its existence, Kelly Field has seen nearly every type of plane used by the armed forces. During the last war Curtiss *Jenny's*, perhaps an occasional Spad and Nieuport were parked on the landing apron. The *Jennys* were then Kelly's number one training ship. More recently Beechcrafts, Fairchilds and Ryans later took the place of these planes as trainers and Lockheed *Lightnings* and Consolidated *Liberators* rolled in as the fighting ships.

At Kelly Field are reminders of the early days of the first war. There are still standing the shabby officers' homes built in 1917 as temporary quarters, a Catholic church and the original hangar line. Intermingled with these buildings are new bits of brick and modernity, miles of runways, the largest operations tower in the southwest and a barracks that houses nearly 2,000 men.

The structures still remain although the training planes have been shipped to other bases. The name, Kelly Field, perhaps will die, too, for on the Army listings the name will be "San Antonio Air Depot" or simply Duncan Field.

Pensacola Expansion

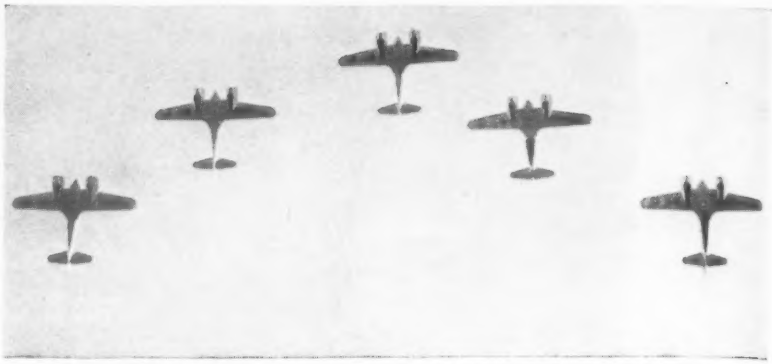
A SIXTH auxiliary air station is to be added to the Naval Air Training Center at Pensacola, Fla., according to an announcement by the Navy Department. It will be located near Milton, about 20 miles from the main station.

The name and date of construction of the new station have not been made public, but it was disclosed that most of a $13,000,000 congressional appropriation for Naval improvements in the Pensacola area would be used for the auxiliary.

The proposed expansion, which will further increase the tempo and scope of Pensacola's Naval air facilities, is in accord with the general growth and development of Naval aviation facilities in that area which began in the early 1930's with the main station. In 1934 the first auxiliary base field, Corry Field, was added.

Training was 12 months long in those days and open to only a few other than graduates of the Naval Academy. The tempo was increased again in 1936 with the establishment of the aviation cadet training program. In 1940, Saufley Field was commissioned and then Ellyson Field in 1941, just prior to the entrance of the U. S. into the war.

The war brought about an unprecedented expansion with the augmentation of facilities and the introduction of new schools and departments. Last fall saw the addition of two more auxiliaries, Bronson and Barin Fields.



FIVE CURTISS AT-9's twin-engined advanced training planes, in "V" formation over Blackland Army Flying School, Waco, Tex. When advanced aviation cadets complete their training in these planes they receive their wings as pilots in the Army Air Forces and are ready to take over big bombers and transports.

Enid Stresses Safety

Reminiscent of "Burma Shave" road signs are the tart Enid reminders.

AN extensive safety program is constantly in progress at Army Flying School, Enid, Okla., to reduce flying risks to a minimum.

Part of the program has been to erect signs at strategical points to remind aviation cadets of safety precautions which will make their flying easier and safer.

The stage house, which includes the dispatchers' and the flight commander's offices, is the building in which the cadet's safety precautions begin prior to a flight. The first sign after he leaves the stage house is a timely reminder to him that he should have checked out with the dispatcher.

As the cadet nears the flying line he sees a sign pointing out the value of planning his airwork. At the end of the walk is the last sign before he steps onto the ramp. It warns him to avoid careless exposure to whirling propellers of the planes on the line.

Completion of a flight does not mean safety precautions are no longer necessary. In order to bring this fact to mind, another group of signs have been placed on the other side of the walk so the cadet will surely see them as he leaves the field.

"What did you learn?" is the first sign. It is intended to make the cadet think about the things he learned during the flight.

His next warning brings out a safety precaution necessary to protect planes and other pilots. Leaving brakes unlocked may cause a plane to roll into another and cause considerable demage and failure to turn a switch off may result in personal injury to a mechanic or another pilot.

The third sign the cadet sees as he walks toward the stage house concerns two forms he must fill out after each flight; a record of his time in the air and the type of flying done and a report on the condition of the ship.

Before entering the stage house, the cadet is warned by a sign that he should not leave the field without reporting to the dispatcher.

Anti-Sub Command Expanded

ORGANIZED only October 15, 1942, to take over the Atlantic coast duties of the First Bomber Command, the Anti-Submarine Command has expanded its operations across the Atlantic. Under a revision of its original orders, the Anti-Sub Command now has the mission of destroying submarines in any theater of war where they can be located.

Since its organization, many air crews have been transferred to the Anti-Sub Command from the First Bomber Command and other replacements and new men have been sent from air-crew replacement centers following special anti-submarine training.

Besides being responsible for the sinking of many U-boats, this command has been assigned jobs of air convoying for coastal and open sea shipping. Officers and men have often taken part in rescue work resulting from the torpedoing of ships off the Atlantic coast.

Lowry Freight Terminal

A NEW air freight terminal has been established at Lowry Field, Colo., to serve coast-to-coast freight planes. The new division at the field has been placed under the command of Capt. Joseph J. Michel.

"We have found LEARADIO EQUIPMENT more than satisfactory and utilize it on all flights."

... writes EDWIN A. LINK, Jr.,
President of Link Aviation Devices, Inc., Binghamton, New York.

THE LINK TRAINER shown above with Mr. Link at the controls, is standard with United Nations Air Forces, for Instrument Flight Training, contributing in no small degree to the superiority of flying skill displayed by our pilots on the battlefronts of the world.

"We have used LEARADIOS in several of our airplanes," says Mr. Link. "Our Grumman Model, G-44, is so equipped. We have found this equipment *more than satisfactory* and utilize it on all flights."

The list of those who use Learadio in their planes is a long one. It includes, for example, such famous pilots as Major Alexander P. de Seversky, Bob Hall, Major Al Williams, Clyde Pangborn, and others.

In fact, Learadio has become known as *"the pilot's preference"* – and is now standard equipment on the better known aircraft, including GRUMMAN AMPHIBIANS . . . WACOS . . . FAIRCHILDS . . . CESSNAS . . . and most civilian and air cadet pilot training aircraft and itinerant types used in the service of the armed forces.

T-30 RCBB transmitter-receiver is an extremely efficient and dependable 2-way aircraft communication system. It's the *"pilot's preference"* because every flying need has been foreseen and every installation problem solved in advance — everything is at the pilot's finger tips.

- ★ Powerful 2-frequency crystal controlled transmitter (2900 KC to 6500 KC).
- ★ Telephone and telegraph emission approx. 20 watts output.
- ★ Three Band receiver—radio ranges (180 KC to 405 KC) broadcast (500 KC to 1200 KC) airway communications (2800 to 6700 KC).

For "three-way radio", the receiver includes new provision for operating from both the conventional antennae and the famous light-weight Learadio loop *(shown above)* providing static-free reception or aural-null direction finding. *(Approved type for C.P.T. Training.)*

Ninety-eight percent of Lear's Production and Engineering facilities are today concentrated on projects of a secret or semi-secret nature. Automatic Electro-mechanical controls of Lear exclusive design are incorporated in aircraft manufactured by Consolidated, Douglas, Boeing, Lockheed, North American, Vultee, Grumman, Curtiss-Wright, Ford, General Motors, etc., now in combat on the world's battlefronts.

LEAR AVIA, INC. (learadio) PIQUA, OHIO

HOLLYWOOD, CALIF. • GRAND RAPIDS, MICH. • CHICAGO • CLEVELAND • NEW YORK

BATTLE-BORN • BATTLE-TESTED • BATTLE-PROVEN
SUPERIOR INSTRUMENTS FOR TOMORROW'S FLYING

From the Nest of the War Birds
Back of the air victories which U. S. Army and Navy pilots are writing into history today have been long months of training and practice. First these pilots have to learn to fly.
This is the job of Kinner Engines—the tough, unending job that is teaching new men the feel of flying.
Building engines that build confidence in the air has been Kinner's job for eighteen years. And Kinner will be a good name to remember after Victory.
KINNER MOTORS, INC. • GLENDALE, CALIFORNIA
Pioneer Builders of 100 H. P. to 300 H. P. Aircraft Engines
KINNER

A letter from General Campbell that we're proud to have you read

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ORDNANCE
WASHINGTON

DEC 22 1942

Mr. R. E. Gillmor, President,
Sperry Gyroscope Company,
Manhattan Bridge Plaza,
Brooklyn, New York.

Dear Mr. Gillmor:

The performance of the equipment which your company has supplied our service for carrying out the past year of combat will undoubtedly be of intense interest to your personnel. It is particularly desired to point out the performance of the Director and Remote Control equipment which your company has supplied for 3" and 90 mm. Antiaircraft Guns.

American troops in the Philippine Islands using the earlier models of Sperry Directors brought down an exceptionally large number of Japanese planes. Sperry equipment performed exceptionally well and contributed largely to the resistance put up in that campaign.

The latest reports come from Guadalcanal in the Solomon Islands where one 90 mm. battery destroyed a total of 18 enemy aircraft in one month using the Sperry Director and Remote Control System. The ammunition expenditure of only 50 to 60 rounds for each plane destroyed is far less than any on record for antiaircraft combat and is a tribute to the Sperry men who have contributed to the extreme accuracy of the director and control. This antiaircraft battery had no trouble in engaging with accurate fire planes flying at high altitudes and has destroyed planes flying at [redacted]

It is suggested that you inform your employees that the equipment which they are building is measuring up to the highest standards and is definitely contributing a part in winning the present conflict. Your company is to be congratulated on the exceptional performance of [redacted] equipment which it produces.

Sincerely yours,

SENT DEC 22 1942 SPGOA 2

L. H. CAMPBELL, JR.,
Major General, Chief of Ordnance.

★ The Sperry Director and Remote Gun-control System are but one example of many ordnance instruments developed through the co-operative efforts of the Ordnance Department and Sperry which enable American guns of all types to fire faster and shoot straighter than those of the Axis.

Sperry Gyroscope Company, Inc.,
Brooklyn, New York
Division of Sperry Corporation

He wrote the letter. Major General L. H. Campbell, Jr., is Chief of Ordnance, United States Army. He knows, from recent trips to the fighting fronts, and by regular reports from the field, how Sperry equipment performs under actual battle conditions.

Iron men plus a metal brain. Crack anti-aircraft crew at their posts with a Sperry Director, the metal brain of the ack-ack guns. This amazing instrument calculates range, transmits firing data by which shell fuses are set and guns automatically aimed so that shells explode at the exact moment when they will do the most damage to an enemy plane.

SPERRY

PRECISION ENGINEERS TO AMERICA

'PARACHUTE' RATIONS FOR AIRMEN

Army emergency rations formerly consisted of hard bread and chocolate (left). Today's pack provides, in concentrated form, the vitamin equivalent of a full course meal such as that being served to Army men in typical mess at the Miami Beach school of the AAFTTC.

A WELL-BALANCED meal in a capsule long has been envisioned by scientist and dietitian alike, but the nearest realistic approach to this compression of calories are the "parachute rations," intended for consumption by flyers of the U. S. Army Air Forces when forced to land in jungle, wilderness or remote battlefront.

These rations, consisting of three cellophane-wrapped packages, weighing about 12 ounces each, represent adequate food requirements for morning, noon and evening meals. They contain, for a day's allowance, about 3,500 calories, packaged in such a tiny kit that one visualizes the food contents as those of a hummingbird embarking on a flying expedition, far from flowers and insects.

Actually these vest-pocket victuals—produced by the Quartermaster Subsistence Research Laboratory of Chicago, and prescribed by Dr. Everett W. Thatcher, co-ordinator of civilian pilot training at Union College, Schenectady, N. Y.—are adequate to the dietary needs of a bombardier forced down on neutral soil after dropping explosives on Rumanian oil fields; a pilot bailing out on the vast desert stretches of Libya; or a "Flying Tiger" lost in a jungle adjacent to the Burma Road. Each package of these emergency rations measures about 1½ by 6½ by 3½ inches, and the three meal allowances are as follows:—

The breakfast ration has four ounces of pemmican biscuit (a kind of cracker containing whole wheat, soya, frozen eggs, white wheat, skim milk, whole oat flour, sugar, molasses, shortening, a salt, cinnamon, and ammonium bicarbonate); two ounces of modified malted milk; one three-ounce can of veal loaf, two soluble coffee tablets; two cubes of sugar and one stick of chewing gum. The noon-day meal includes eight pieces of pemmican biscuit; a tube of bouillon extract; a package of 15 dextrose tablets; a tin of bone-spread and a piece of chewing gum. The package of "D" ration for supper consists of chocolate, sucrose, dry milk, lemon powder in a little cellophane bag, chewing gum, three cubes of sugar and a tin of sausages.

Whether testing guns at the Aberdeen, Md., proving grounds, or new aircraft at Wright Field, Dayton, O., Uncle Sam subjects his products to gruelling and even punishing experiments. Nor did these "parachute rations" escape suitable "proving grounds" to determine their fitness. The scene was a vast desert in the Santa Fe, N. M., national forests and a 14-man expedition followed the meanderings of the parched, shallow Jemey Creek. Three officers attached to the Aero Medical Research Laboratory at Wright Field, seven enlisted men and four college professors were the duly appointed human "guinea pigs" to determine the worthiness of these vest-pocket victuals.

The hike across the desert and the ruggedness of portions of the terrain were not the only conditions that made the expedition uninviting. The maximum temperature experienced was 127° Fahrenheit, and the official air recordings on that same day were 90° in the shade. The party plodded from 13 to 21 miles daily, at altitudes varying from 5,000 to 9,000 feet above sea level. Strenuous exercise, excessive heat and the lack of water accounted for weight losses of the men, some losing three pounds daily. The emergency rations were absolved of any blame for the deteriorating conditions of these temporary "soldiers of fortune," as they marched 100 miles in the interest of the science of dietetics. "Each man was weighed twice daily," reported Dr. Thatcher, "before breakfast and at the end of the day's trek. Blood tests were also made each morning before breakfast and at the end of the day. Except for sunburn and a few blisters, the men wound up in much better physical shape than when they started."

These human "guinea pigs" were laboratory workers—some of them college professors—and were, therefore, unaccustomed to physical exertion. In this gruelling experiment across hot desert sands and over mountain peaks the men perspired freely, and one man drank six quarts of water in 24 hours. Comparative tests were made with other rations, one being a meat stew, which had to be heated to be palatable, plus biscuit and coffee; and another diet of just pemmican biscuit alone. The latter proved so unpalatable that it was abandoned, and the "parachute ration" given instead. Four of the men, who ate it for five days, described it as "adequate and not unpleasant." The 3,500 calories which it provides are about one-half more than the average sedentary person needs.

Leaving terra firma and going aloft with the U. S. Army Air Forces, how will this new product of ultra-modern dietetic science be carried on flights? Pilots will include it in their "jungle kits," attached to the parachute pack. This also contains a machete knife (used in the jungles to cut anything from fingernails to foemen), and first-aid supplies. Hence the descriptive term "parachute rations."

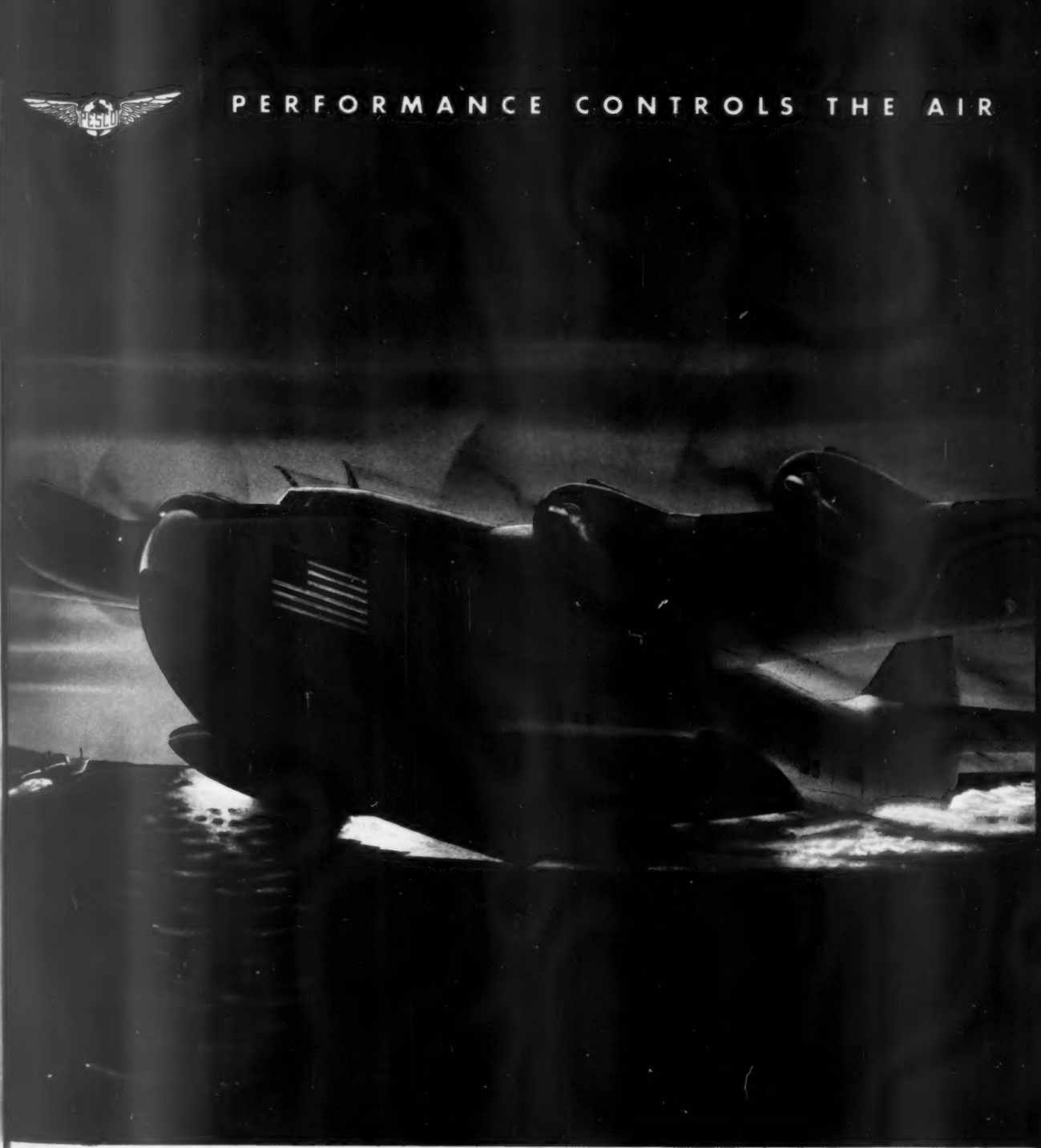
"Marauder" Mechanics

The first class has been graduated from the airplane mechanics school at the Dodge City, Kans., Army Air field after an intensive four weeks course in maintenance of B-26 Martin *Marauder* bombers.

Headed by Maj. John D. Todd, Houston, Tex., post operations officer, the school was set up to provide crews for the servicing of the medium bombers in which student officers soon will be perfecting their pilot training at this new AAF transition flying school.

The mechanics course is an intensive study of the *Marauder* and a refresher on plane mechanics in general.

PERFORMANCE CONTROLS THE AIR



PESCO high capacity Air Pump, for suction and pressure.

A Clipper spreads its wings for the stars and stripes. Over six continents . . . across vast stretches of ocean, jungle and desert . . . vital war communications are streamlined. Every flight is an urgent mission that *cannot* fail. Performance of every part in the plane must be faultless. Our job here at home is to see that every part is a model of precision.

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories...

PERFORMANCE POINTS TO Pesco FIRST

DIVISION BORG-WARNER, CLEVELAND, OHIO

When the alert sounds, there's no time for fumbling with stubborn hooks and fasteners on a parachute harness. That's why Joyce hardware has been designed for streamlined efficiency. It's only a matter of seconds to put on a parachute harness with Joyce fittings.

Seconds are precious, lives are precious. That's why leading parachute makers use Joyce fittings. They have learned to rely on the precision of every piece bearing the name of Joyce. And they have learned, too, that Joyce Aviation, Inc., *always delivers on time!*

AIRCHOX COMPANY, Division of

JOYCE *Aviation*, INC.

General Offices, 8 So. Michigan Ave., Chicago

MAKERS OF THE WORLD'S FINEST PARACHUTE AND BELT HARDWARE

Ellington Field Grad, '17

Jack Knight

WHILE the young fry training at Ellington Field, Tex., are odds-on favorites to bring glory to themselves as the pilots, bombardiers and navigators of this war, there is another graduate — of World War I—who already has carved a name for himself in aviation and in so doing has flown better than 18,000 hours and two and a half million miles. This pilot is small, wiry Jack Knight who is now chief of flight operations in South America with the Defense Supply Corps.

A draftsman for the Mead-Morrison Engineering Corp., Chicago, when the call for pilots went out in 1917, Knight left his desk and eventually reported to Ellington Field for flight training. He learned to fly so well that he was kept at the field later as an instructor in advanced aerobatics, against all his pleas that he be given an overseas assignment.

With the Armistice, Jack Knight returned to his draftsman's board, but soon the whine of airplane engines over the office became too much and Knight left to join the pioneer airmail pilots. When airmail became almost routine, Knight left this phase of flying for the rapidly growing passenger field. He became a pilot for National Air Transport, and flew one of the legs on the first night air mail transcontinental trip. When NAT became part of United, Knight continued flying for the new company, remaining with it until 1942 when he became supervisor of CPT for the CAA.

Officers and Ladies

AAF nurses stationed at Mather Field, Calif., have decided it takes more than a smart blue uniform, the rank of a first or second "looie" and shoulder insignia to make an officer. At their own request, they are studying a streamlined officers training course.

Studying both in classroom and field, the nurses are taking courses in military courtesy, safeguarding military information, Articles of War, oxygen and high altitude flying, aircraft identification, assembling and firing sub-machine guns, history of aviation, the theory of flight, navigation and weather.

They're All There

AN occupational survey conducted at the San Antonio Aviation Cadet Center recently revealed there are enough trades and professions represented among the embryo pilots, bombardiers and navigators to start a model little town.

At random, one finds telephone men, file clerks, window cleaners, accountants, statisticians, teachers, turret lathe operators, farmers, buyers, steel workers, theater managers, credit adjusters, truck drivers, painters, criminologists, newspapermen and photographers.

We have two reasons to be proud of this Flag

First, of course, we are proud of the Army-Navy "E" flag because it is an award to the 3,000 employees of our Richmond refinery. We have long known that their energy, devotion and skill merit the highest praise.

The other reason is that this flag is a harbinger of better days to come, when we will take pride in offering to industry the fruits of Richmond's tremendous war effort.

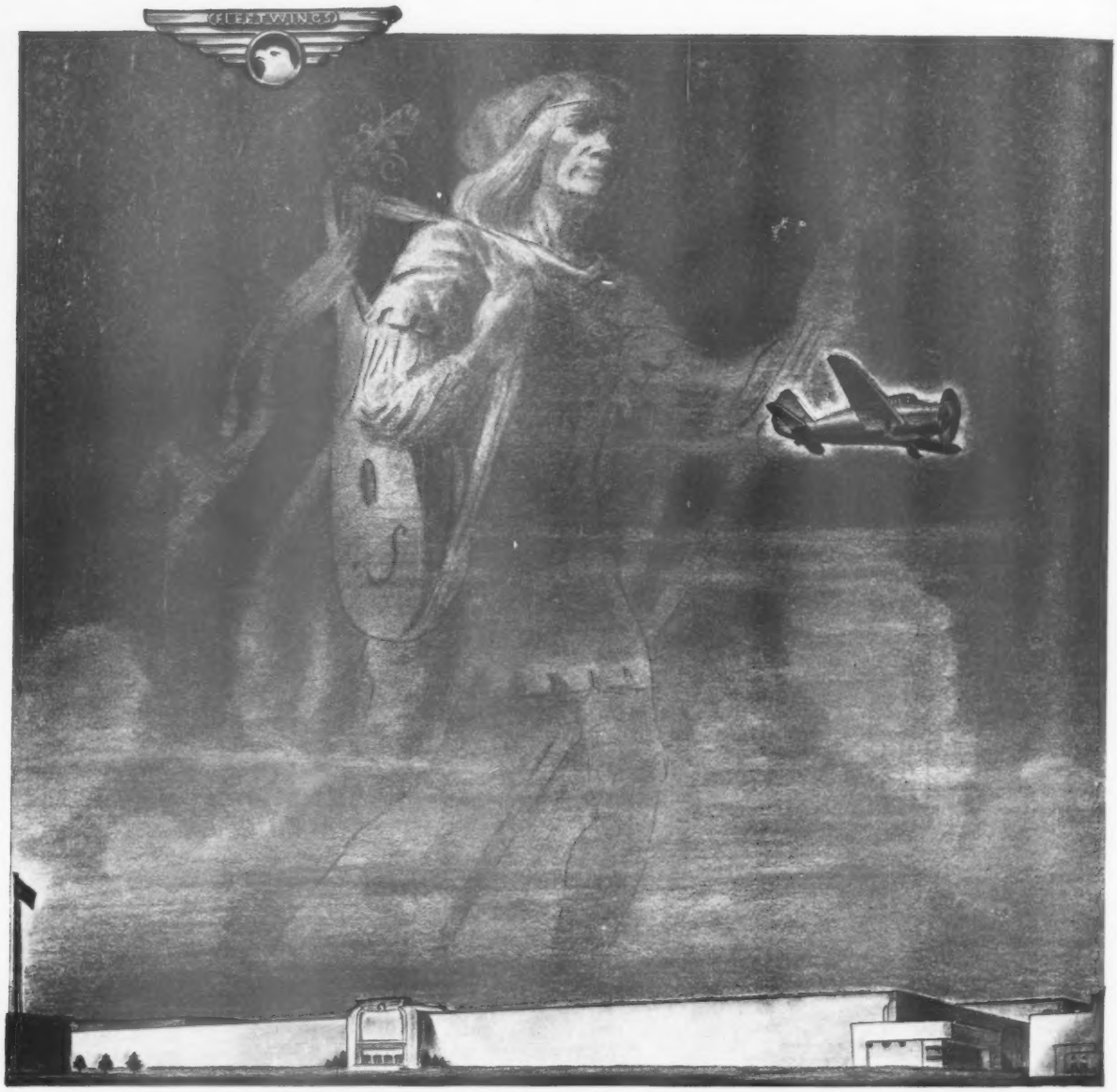
Today we can only hint at the giant strides our petroleum research and production have made. We cannot publish the specifications of a host of new products, nor the story of how old products have been sensationally improved. We cannot describe the system by which these products are distributed on a world-wide scale.

But we can promise you that, when these facts become known, they will open new horizons for American businessmen and technicians in many fields. They will prove once again that "know-how" and determination can turn yesterday's impossibilities into tomorrow's accomplishments.

Quality-Service STANDARD

In the meantime, the Richmond refinery and all of Standard of California are living up to the Army-Navy "E" flag, helping bring the inevitable victory nearer.

STANDARD OIL COMPANY OF CALIFORNIA



For every hero—one Blondel

BUT for the faithful Blondel, Richard the Lion-Hearted might never have returned from the Crusades . . . he would have died a prisoner in the Tyrol.

Today's heroes have their "Blondels," too . . . in the plants and factories that supply the equipment for war.

At Fleetwings, for example, the "Blondels" are building planes . . . sturdy Fleetwings' basic trainers for the Army's fledgling bird-men. And they are building parts . . . wings, fins, stabilizers, ailerons, tail assemblies, fuselage sections, and hydraulic equipment for many of America's bombers and fighting planes.

Working with practically every aircraft material . . . with stainless and other steel alloys, with aluminum, with plywoods . . . the men and women at Fleetwings are fighting a supporting action that's felt all the way to Berlin, Rome, and Tokio.

But today's production, vast and important as it is, is not all. The Fleetwings' pioneering that developed the first all-welded, stainless steel military plane is continuing . . . unabated. Victory will find Fleetwings qualified and ready to serve as "Blondel" to the air needs of the Peace.

(Plant No. 1)

FLEETWINGS

Incorporated

BRISTOL • PENNSYLVANIA

FLEETWINGS

pioneers with parts and hydraulic equipment

The BT-12, all-welded basic trainer built for the U. S. Army Air Forces.

A NEW ELECTRICAL GAGE, capable of automatically measuring the strain developed during static tests is now in use at Fleetwings to speed the testing of aircraft structures. With this device, it is possible to measure and make a permanent record of the strain developed at 48 different points of a structure—all within a single minute.

THE "DUCKS" HAVE FLOWN from our lofting rooms since the advent of the new Fleetwings-developed Spline-Lock. The Spline-Lock, essentially, is a rubber vacuum cup with a hook or "finger" attached. Primarily designed for holding splines on vertical lofting boards where the old lead weights or "ducks" are impractical, it has been found they are equally efficient on horizontal boards since they hold down the splines much more securely.

FROM THE HYDRAULICS DIVISION comes word of the large variety of tests to which all Fleetwings' hydraulic equipment is submitted before leaving our plants. Every flying condition is duplicated during the tests—and valves function perfectly or are rejected. A "stratosphere box," for example, filled with dry ice, reproduces the sub, sub-zero temperatures encountered in high-altitude flying. Other tests reproduce tropic heat, make sure that the valves are leak-proof and will stand body pressures of 2,500 lbs. per square inch.

"THE ARROW" is the name of the monthly magazine issued by Fleetwings describing production shortcuts and other news of interest to men and women in the aircraft industry. If you'd like a copy each month, write us on your company stationery. Send your request to "The Arrow," Fleetwings, Inc., Bristol, Pa.

"KEEP 'EM FLYING!"

FLEETWINGS

Incorporated

BRISTOL • PENNSYLVANIA

Ship Identification

This adjustable model aids pilots in learning to identify surface vessels.

LIEUT. BERNARD A. ANDERSON, assigned to the Blackland Army Flying School at Waco, Tex., has built a 55-piece demonstration kit with which he can construct a model of any U. S. battlewagon.

A former instructor at the University of Wisconsin, the young ship identification teacher has constructed the set so that he can graphically describe to his students positions and types of masts, turrets and stacks—the three major identification characteristics of all warships.

In teaching his classes, Lieutenant Anderson stresses that the general outline of a ship is the best means of identifying it. In keeping with theory, he has eliminated in his models all small detail parts which would not immediately be seen by a pilot several thousand feet over the ocean.

A much higher percentage of accuracy has been found in students learning through the Anderson method than through other methods used in teaching this subject.

Chicago Bomber

GRADUATE of Ellington Field bombardier school, Lieut. Bernard LaVelle Bell, 28, has the honor of being the first American officer to press the bomb release while flying over German-occupied territory. Failing to "click" as a pilot, Bell was transferred to the bombardier school and graduated January 7, 1942. The exact date of his dropping the "first" is not given. Before applying for aviation cadet training, the officer was a bookkeeper in the Lake Shore Trust and Savings Bank of Chicago.

Note to Adolph

IN a press release "memoed to Shickelgruber," an Army press relations officer writes "that cadets at Randolph Field have spent 491,263 hours in the blue Texas skies—nearly enough to carry every one of the 500,000 men your institution cost Naziland at Stalingrad for one hour . . . or . . . one man could have stayed aloft 56 years. That's nearly six times as long as you have been up in the air as Germany's Fuehrer."

Change at Mather

BRIG. GEN. LELAND R. HEWITT, in command of Mather Field since its reactivation in May, 1941, has been assigned command of the 35th Flying Training Wing. Replacing General Hewitt is Col. Trenholm J. Meyer.

THE AAF'S "CADET KNUCKLEHEAD"

ONE STRAWBERRY ICE CREAM CONE PLEASE! —
Don't LAND OUTSIDE SPECIFIED AREA WITHOUT AUTHORITY EXCEPT IN AN EMERGENCY!
ICE CREAM

No. 5 in the series of specially prepared drawings used by the Army Air Forces to impress upon aviation cadets the "wrong" way of conducting themselves in air.

Victory hangs in the balance.

ROHR

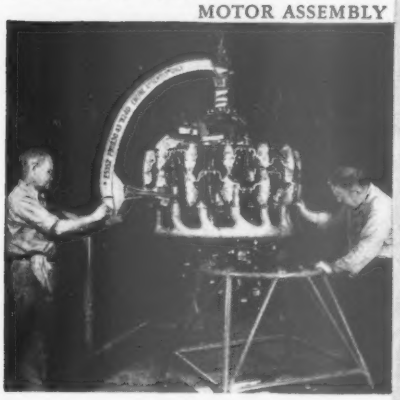
PARTS ☆ ASSEMBLIES

The **ROHR** *TILTING* Arc is typical of American ingenuity which is swinging the production balance further in favor of the Allies. It is just one of the many specially conceived devices and methods by which Rohr Production Fighters speed their thousands of tasks to ready Rohr equipped planes for the war front.

The Rohr Tilting Arc enables *fewer* men to turn out *more* work in *less* time and with *less* fatigue. It suspends heavy aviation motors in so delicate a balance that the pressure of a workman's hand moves them to any position within a 90° arc. Its application to fields of final assembly and advanced base repair increases its win-the-war service immeasurably.

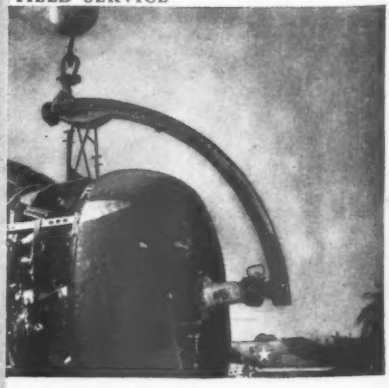
HELPING TO WRITE
THE STORY OF TOMORROW

CLEANING A MOTOR



MOTOR ASSEMBLY

MATING A WING



FIELD SERVICE

ROHR AIRCRAFT CORPORATION

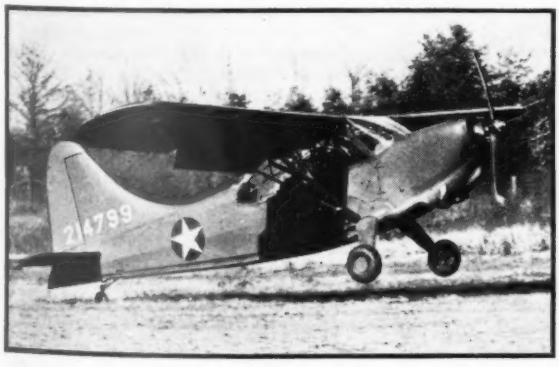
CHULA VISTA, CALIFORNIA

Industrial Aviation SECTION

Consolidated's B-24 "Liberator," a heavy bomber with retractable tricycle landing gear.

The Vultee "Vengeance" is one of the newest of the bombers now being produced under the Consolidated-Vultee banner.

Illustrating the wide range of aircraft manufactured by the merged company is the "Sentinel" Army liaison plane.



CONSOLIDATED VULTEE MERGER COMPLETED

THE uniting of Consolidated Aircraft Corporation and Vultee Aircraft, Inc., into the Consolidated-Vultee Aircraft Corporation marks the completion of one of the biggest mergers in the history of the aircraft industry. The deal joins these former affiliates into a single company which will continue producing a diversified line of aircraft under the combined management of officials of both organizations.

Since Vultee, which pioneered mass production in the aircraft industry, made jobs for and hired the first women to release manpower to the services, makes relatively small planes and Consolidated long has specialized in multi-motored equipment, the two firms complement each other.

Liaison planes, dive bombers, large land bombers and cargo-planes as well as long-range flying boats are among the products of the new company. In addition the new company also is engaged in a large Army personnel training program and is operating an airlines service for the Government.

From a purely operating standpoint, the merger permits utilization of combined plant and personnel, without regard to corporate boundary lines, to provide maximum output. The management of the new company is directing energies toward one end—prosecution of the aircraft building program for winning the war. All other considerations are subordinate to this single purpose.

On December 7, 1941, Consolidated was operating at San Diego only, concentrating on the production of *Liberators*

TWENTY YEARS of building big, tough ships—flying boats capable of landing and taking off in a rough sea—taught Consolidated Aircraft a lot of things that are coming in handy today. Handy—not only in the building of the great "Coronado" and "Catalina" Navy patrol bombers, but also in constructing their famous "Liberator" land-based bomber so it can ride the "waves" of flak over enemy territory.

And Consolidated means "big" in more than aircraft alone. In planning, in manufacturing, in vision, too. When the Japs back-stabbed at Pearl Harbor, Consolidated PBY's or Catalinas were already on patrol over the Pacific; Liberators were already in service with the British Coastal Command. And Consolidated was completing the first continuously moving assembly line for heavy bomber building!

Thus Consolidated takes its place as another of those "names we must never forget"—with a name that stands for superlative American aircraft, built to do *specific jobs* as our armed forces want them done . . . building better wings for war, that the wings of peace may spread sooner.

NAMES *the U. S. must never forget*

AERONCA
AIR CRUISERS
BEECH
BELL
BOEING
BOWLUS
BREWSTER
CESSNA
COLGATE
★CONSOLIDATED
CULVER
CURTISS-WRIGHT
DOUGLAS
FAIRCHILD
FLEETWINGS
FLETCHER
FORD
G & A AIRCRAFT
GENERAL MOTORS
GOODYEAR
GRUMMAN
HOWARD
INTERSTATE
LOCKHEED
MARTIN
McDONNELL
NORTH AMERICAN
NORTHROP
PIPER
REPUBLIC
RYAN
STEARMAN
TAYLORCRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
VULTEE
WACO

What's the most important part of an airplane? There *is* no *most important* part. An airplane is the greatest example of industrial teamwork you ever saw, and the Roebling Control Cord that carries the pilot's skill to elevators and rudders and ailerons is just one of many hundred products that must be right, and strong, and lasting. But we build it as though it were the most vital part of every ship that carries it. John A. Roebling's Sons Company, Trenton, New Jersey. Branches and warehouses in principal cities.

JAR ROEBLING

*In these frequent messages, Roebling salutes each member of the aircraft industry in turn.

ROEBLING

means Control in the air

(B-24's), *Coronados* (PB2Y's) and *Catalinas* (PBY's). In March, 1942, the company began operations in Texas, in a Government-owned plant which will be one of the world's largest integrated airplane factories. There, *Liberator Expresses* (C-87's) are rolling off the longest mechanized assembly line ever built for large aircraft.

Later in 1942, the corporation opened Government-owned modification plants in Arizona, and in North Carolina, where planes are prepared for operations under many varied combat and climatic conditions. Starting later this year, the company will operate a Government plant in Louisiana. There it will produce the new P4Y flying boat for the United States Navy.

Late in 1942, the Stout Research Division of the company was established at Dearborn, Mich. It has acquired certain of the properties and developments controlled by William B. Stout. Stout will direct this division for the new company.

In addition to all this, Consolidated has been operating (since May, 1942) a scheduled air transport line, Consairways, in foreign service for the Army Transport Command. For reason of military secrecy, details of this operation cannot be revealed.

In the training field, the company, working with the Army Air Forces, began in May to instruct Army personnel as airplane mechanics on a mass basis, graduating 600 men every 30 days as specialists on the *Liberator*.

The Vultee plant at Downey, Calif., continues to devote the major part of its efforts to the mass production of *Valiant* basic trainers, with some time being devoted to the building of parts for *Liberator* bombers. The Nashville, Tenn., plant is concentrating on making *Vengeance* dive bombers; the Vultee plant at Wayne, Mich., on producing *Sentinel* liaison planes and *Reliant* navigational trainers. [The latter two aircraft were originally produced under the Stinson name. However, the Stinson company was acquired some time ago by Vultee and now comprises a unit of the Consolidated-Vultee organization. The *Sentinel* originally was the Stinson O-49; the *Reliant* retains the name so widely popularized by Stinson before the war.—Ed.]

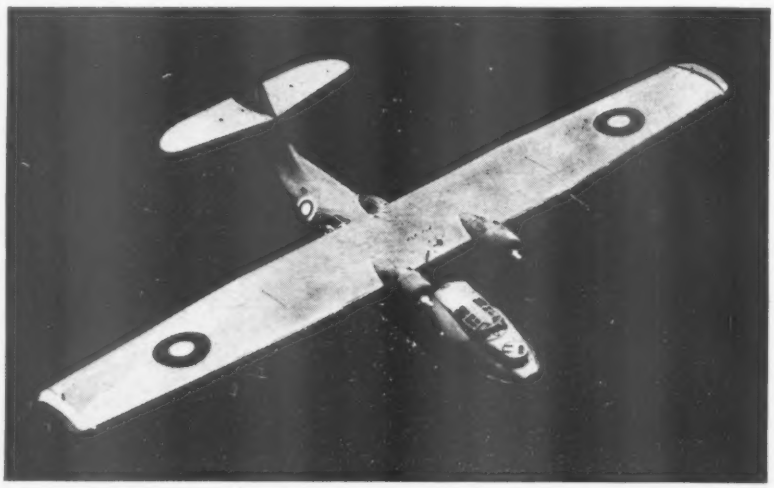
In July, 1942, Vultee acquired all the outstanding stock of the Intercontinent Aircraft Corporation with a plant at Miami, Fla. Intercontinent produces aircraft parts to several companies, including Vultee, and also makes ordnance.

Late in the summer Vultee established a modification center in Kentucky.

As rapidly as aircraft facilities can be rushed to completion, Consolidated-Vultee will inaugurate large-scale production at a new plant under construction in Pennsylvania.

At the Vultee division a currently operating program of engineering research and marketing analysis is making a study of the various aircraft types which may best be adapted to peacetime production facilities of the new company.

Emphasis on long-term development is indicated at Consolidated by the acquisition of the Stout Research Laboratories and their director. At present, however, Consolidated is devoting itself to building a military airplane which already has well earned its plaudits in the war, and has in the development stage several new models. One of these is a 400-passenger airplane announced recently by Tom Girdler, now chairman of the board of Consolidated-Vultee.



A famous member of the C-V family is the Consolidated "Catalina" patrol bomber.

The following is a list of the products of the company:

Liberator (B-24) long-range patrol bomber. Four-engined with a wingspread of 110 feet, length of 66 ft. 4 in., and a gross weight of more than 28 tons. A speed of more than 300 m.p.h. makes this the fastest large bomber now produced on mechanized assembly lines in the United States.

Liberator Express (C-87) long-range transport. A modification of the famed *Liberator*, this plane will carry a six-ton payload over 3,000 miles.

Catalina (PBY) long-range patrol bomber. The "eyes of the Fleet," this ship is produced both as an amphibian and as a flying boat, and its maximum

CHAMPION SPARK PLUGS

firing at the extreme pressures and temperatures encountered in our latest turbo-supercharged, high altitude aircraft engines have compiled an unequalled record for dependability. Champions are on active duty on every front.

C26S—Shielded

In the piercing cold and rarefied atmosphere of the sub-stratosphere, where air supremacy is gained, spark plugs must provide their life-giving sparks under most abnormal conditions. To meet these abnormal conditions, exhaustive research, specialized engineering and uncompromising manufacturing standards are combined to give our air forces spark plugs with the same characteristic dependability that has made Champion Spark Plugs the ultimate for earth-bound engines.

Now on active duty on every front, and widely used in engines of every type, Champions are piling up records for outstanding performance, long life and dependability. This is directly due to certain inherent and exclusive features of design and construction plus special ceramic insulation, with the following exclusive advantages:

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

C26—Unshielded

USE CHAMPIONS AND FLY WITH CONFIDENCE

range is more than 3,000 miles.

P4Y flying boat. Powered by two 2,000 hp. engines, this airplane is the fastest of its type in the world. It carries a crew of seven, has a wingspread of 110 feet.

Valiant trainer. The Army, Navy and Marine Corps use the sturdy BT-13A and BT-15, as well as SNV-1, as a basic trainer. It is also supplied to several countries among the United Nations.

Vengeance dive bomber. Designated by the Army as the A-35, it has the tactical performance necessary for world-wide usage. It is powered by a 1,700 hp. Wright engine, has heavy armor plate to protect the crew and vulnerable parts, has high caliber wing guns for ground strafing and flexible guns mounted in the rear cockpit for protection.

Vultee *Sentinel* liaison plane. This new ship, small, rugged and known as the "flying jeep," is known officially as the L-5. It has a wide speed range, varying from a hovering speed of less than 45 m.p.h. to fast performance for a ship of its type. The plane, a high-wing monoplane, is powered with a 190-hp. Lycoming engine.

Vultee *Reliant* navigational trainer. Used to teach British flyers navigational training. This is an adaptation of the famed gull-winged commercial Stinson job of several years ago. It is powered by a 290 h.p. Lycoming engine, has a constant speed propeller, and seats four. It is also fitted out with complete navigational instruments. It is known in the United States as the AT-19.

MASS TESTING EQUIPMENT

VEGA AIRCRAFT CORP. has developed a diversified line of instrument and electrical testing equipment which can be used by inexperienced employees with very little training. This laboratory was made possible through the cooperation of shop personnel and instrument and electrical manufacturers with the Vega engineering department.

Since large scale production of aircraft is a relatively new field, equipment for production testing by the inexperienced operator had never been made commercially available. Up to now, this has been strictly a job for a highly trained and skilled expert.

The accompanying photo is an example of this development. The large panel shown is used for general testing in conjunction with specially designed pieces of test apparatus, such as the intervalometer tester the girl is shown using. On the large panel are tested hundreds of instruments and electrical equipment that go into modern warplanes.

The intervalometer is a highly accurate instrument used in conjunction with the bombsight. While in itself complicated, the intervalometer is simple for the bombardier to adjust. By turning only two dials, he automatically can drop a predetermined number of bombs on a target at any desired spacing along the ground, regardless of his speed or altitude.

Vega worker Virginia Harrigan tests an intervalometer, an adjunct of bombsight.

This specially designed tester quickly indicates whether or not the intervalometer correctly performs its various functions of timing and spacing accurately. Both the intervalometer and the tester are intricate pieces of equipment, yet both may be used with a minimum of instruction.

SAVE KOH-I-NOORS

they are good to the end

SAVE DON'T WASTE PENCILS

Today, with forced economies facing you at every turn, it is more than ever necessary that you choose your pencils with infinite care.

KOH-I-NOOR DRAWING PENCILS bring you every pencil quality—smoothness, density of line, accurate grading and long wear.

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KOH-I-NOOR PENCIL COMPANY, INCORPORATED

373 Fourth Avenue New York, N. Y.

BOEING HONORS ALLEN

THE Boeing Aircraft Company's new high speed wind tunnel and aeronautical research laboratory has been named for Edmund "Eddie" T. Allen, Boeing pilot and research scientist who was killed recently in an airplane crash.

As director of flight and aerodynamics for Boeing, Allen had been in charge of the planning and development of the new building.

Although best known to the world as an outstanding test pilot, "Eddie" Allen will be remembered in aviation history for his scientific developments and aerodynamics. His method of exhaustive, analytical flight-testing, combined with an equally thoroughgoing program of wind tunnel research and engineering study, has brought about many of the refinements which have made *Flying Fortresses* and other Boeing airplanes outstanding in their respective fields. His systematic approach has become not only a permanent working procedure of the Boeing flight and aerodynamics division, but many of his methods have been studied and adopted by other aircraft companies as well.

A portion of the Allen Memorial Laboratories and adjacent offices are occupied by Boeing aerodynamic research personnel, while the wind tunnel itself will be ready for use as soon as the specially designed and manufactured mechanical equipment can be installed. It is expected that it will be in service by mid-summer.

Two months previous to his death, Allen was awarded the highest honor of the Institute of Aeronautical Sciences in being selected to deliver the Wright Brothers Anniversary Lecture. Allen chose as his subject the Advancement of the Science of Flight Testing.

He first came to Boeing in 1928 to help in the testing of Model 83, a pursuit ship which was the forerunner of the well-known Navy F4B's and the Army P-12's.

Known as a "big ship pilot," Allen performed the initial tests on most of the large aircraft developed in this country, including those produced by companies other than Boeing.

The Man at the Lathe Fights Too!

...and every turn of the spindle, as he guides his work through many precision operations, helps bring Victory one step closer.

Hours spent at a lathe may lack the dangerous excitement of combat—but the valorous men on the battle fronts breathe a prayer of thankfulness for guns, shells, planes, tanks—for all the superb equipment which is helping them swing the tide against the Axis.

So the man at the lathe is a soldier, too, as he bends his shoulders to the task of pouring out weapons in an ever-increasing stream. He faces his task grimly...proudly...proclaiming by the gleam in his eye and the jut of his jaw that he will not be outdone in service to his country, and knowing that America's production is a decisive factor in the war.

To help America "tool up for Victory," the output of South Bend Lathes has been increased (we can't say how much) in the last year and a half—giving the man at the lathe the efficient, dependable production weapon he must have to win.

There is a South Bend Lathe for every class of work—engine lathes, toolroom lathes, and turret lathes. Write now for our new catalog No. 100B in which the entire line is illustrated and described.

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 36 YEARS

SOUTH BEND, INDIANA

NON-SKID TIRE FOR ICY LANDINGS

RECENTLY developed by Goodyear's C. J. Burkley is a non-skid tread designed for use on planes landing on icy strips. Principal feature of the new design is the use of small metal springs which are imbedded in parallel rows around the tread of the tire. The tires are then put in molds and baked, giving them the familiar Goodyear tread design.

When landing on ice, the metal projections scratch and claw at the surface and give added traction to the plane's brakes. Engineers claim that these tires also aid in take-offs by reducing skids.

While the tire idea has been under consideration for many years, landing problems encountered by U. S. forces in Alaska and other northern fields of operation gave the necessary amount of added impetus to its development.

Improved in War!

. . . for Better Peace-Time Reception

The rigors of modern warfare are the world's finest proving grounds for communications equipment . . constant usage and unusual operating conditions in every climate are a severe test of the communications receiver. Hallicrafters equipment is proving its high quality performance capabilities with our armed forces.

Hallicrafters communications receiver Model SX-28 (illustrated) 15 tubes, 6 bands, delivers outstanding reception . . your peace-time model will be worth waiting for.

hallicrafters
CHICAGO, U. S. A.

The World's Largest Exclusive Manufacturer of Short Wave Radio Communications Equipment

WIRE STITCHER

A FORM of the ancient art of sewing has resulted in time-savings by unskilled labor of as high as 90 per cent in the production of various sub-assemblies going into America's warplanes. This novel procedure is the result of a new-type stitching wire developed by American Steel & Wire Co.

The wire permits the stitching or binding of various types of materials much as pieces of paper are stapled together by an ordinary desk stapler. It is particularly adaptable to the fastening of rubber, plastics, fibre board, laminated wood and other construction materials to stainless steel or aluminum. Its use permits stitches to be made at the rate of several hundred per minute and already remarkable savings of time have been made by several leading aircraft manufacturers in the application of rubber sealing to hatch doors, landing gear doors and similar parts.

The new stitching wire is of a special analysis and was perfected only after months of research and development by the wire company. It has a guaranteed minimum tensile strength of 290,000 lbs. per square inch and it has a zinc coating which withstands salt spray for a period of several hundred hours.

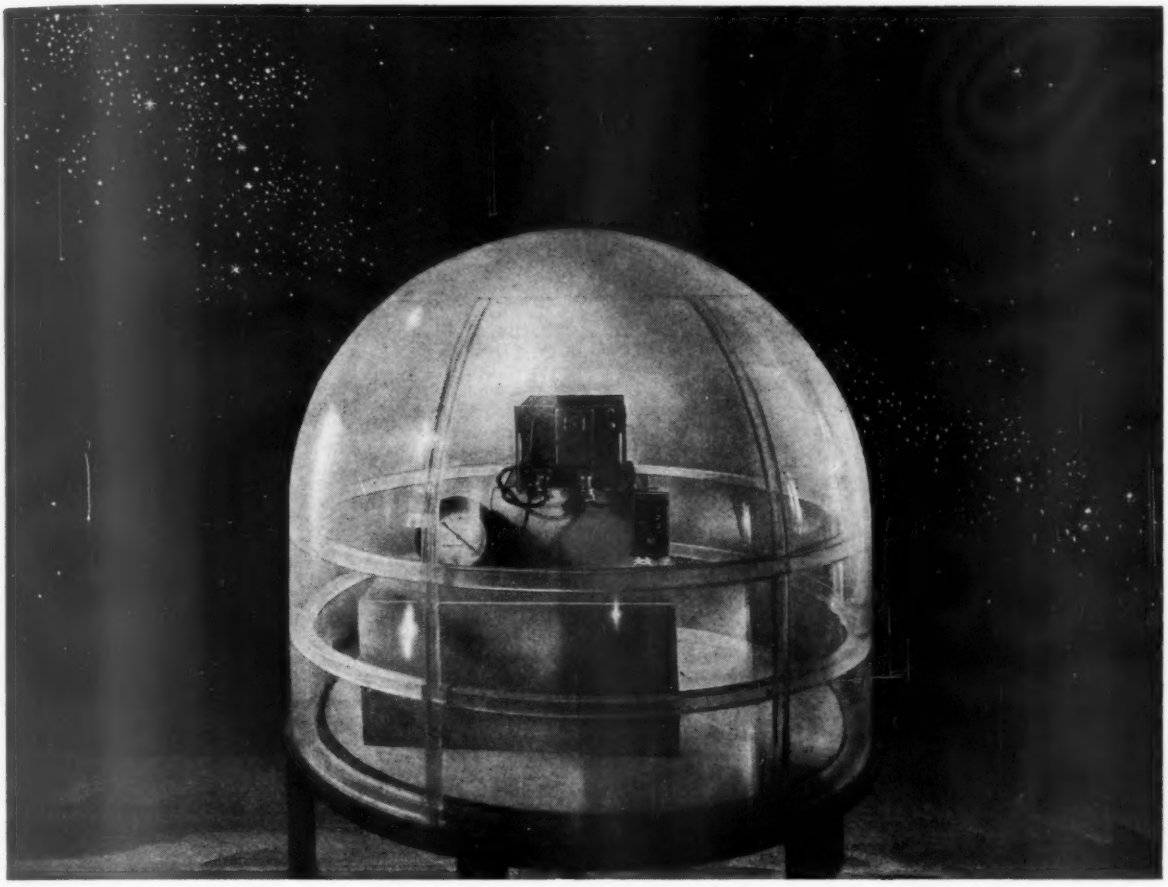
AVIATION SUBSIDIARY

E. C. BOWERS, president, Wickwire Spencer Steel Company, recently announced the formation of a new subsidiary organization, Wickwire Spencer Aviation Corporation, with administrative offices in New York City and plant facilities in Virginia and Illinois.

FIRE FIGHTER

Carbon dioxide smothers engine blaze.

FITTED in many of the planes being built for the armed services today are automatic and manually operated carbon dioxide fire fighting units. One of these units, installed in a Pan American *Clipper* was recently photographed in action as the jets of carbon dioxide shot streams of the gas into all nooks of the engine.



ALTITUDE: 40,000 FEET

Inside this new RCA plastic altitude chamber, aircraft radio equipment is taking a ride at 40,000 feet. As the pressure drops inside the sealed, transparent walls, expert eyes observe every part of the radio mechanism. Defects in design, details of faulty construction that would remain hidden until actual high-altitude flights, can be noticed at a glance *right on the ground*—and corrected *before* the radio is installed in a plane.

For pilots it means greater safety, better performance, *dependability*—where failure of the radio equipment might mean difficulty for a courageous crew.

RCA's new all-plastic test chamber represents another step forward in aviation radio research. Because it is entirely transparent—it enables engineers to study the *whole* set at once, to check for high altitude flash-overs and leaks at the same time, to look for tuning shifts and "breathing" parts in the set simultaneously.

This most advanced of high-altitude test chambers is typical of RCA's many facilities for aviation radio research. Today that research has but one goal—to help make America's armed might in the air the most powerful and effective flying force in the world. From that war-time research will come the knowledge, the skills, and the technique that will help *keep* America's wings the mightiest and most useful known to man.

RCA

RCA AVIATION RADIO

RCA Victor Division • **RADIO CORPORATION OF AMERICA** • Camden, N. J.

NEW ENGINE FASTENER

DR. Edward L. Mack, formerly of the faculty of Cornell University and for 10 years director of research and development for the Reynolds Metals Company, has been granted two United States patents covering an improved type of fastening device for aircraft.

This project originated many months before Pearl Harbor, at the suggestion of a prominent Washington official who foresaw the need for a stronger and safer means of attaching the engine cowlings on high-speed airplanes. The new fastening was accordingly designed with a full consideration of the greatly increased stresses and the complex vibrations which have necessarily accompanied the introduction of larger engines, particularly of multi-engined craft.

Dr. Mack and his associates are now working in conjunction with D. C. Hungerford, president of the Aircraft Parts Development Corporation, of Summit, N. J., to complete the final phases of the engineering, including production tool design for a full line of the new fasteners, which it is hoped will be put into quantity production at an early date.

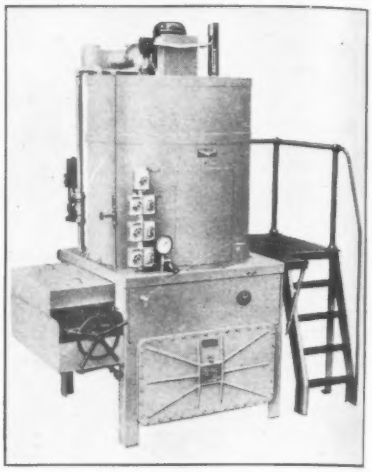
FIGHTING WORDS

FOUR Army pilots who have flown in combat and in air raids over North Africa have recorded their experiences for American aircraft workers who made their planes.

Made at an advanced AAF base, the recordings have an authentic background of fighter and bomber plane activity. The original recordings were flown to Washington and additional copies made.

The reports include experiences aboard a Lockheed *Lightning*, Boeing *Flying Fortress*, Douglas *Boston* and a North American *Billy Mitchell*. Prime and subcontractors of these planes may obtain these recordings through the Industrial Relations Section, Bureau of Public Relations, War Department, Washington.

OIL RECLAIMER

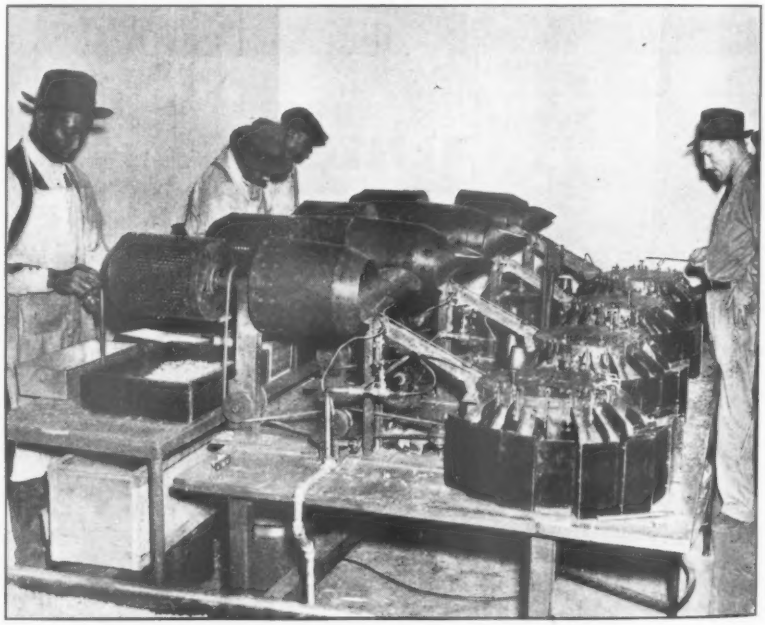


Machine salvages aircraft engine oil.

A NEW model oil reclaimer designed for aircraft engine builders—to be used in salvaging the high grade oil drained from the aircraft engines they test, is now being manufactured by the Youngstown Miller Company, Sandusky, O.

These new models have a capacity of 200 gallons of oil every 90 minutes.

INGENIOUS SORTER SAVES RIVETS



Cylinders at left assort sizes and machines at right grade rivets by length.

A MECHANICAL rivet sorter has been put into operation by the Fisher Body Division of General Motors which daily saves 200 pounds of rivets that otherwise would be lost.

Rivets swept up from the production floors are dumped into one unit of the machine which sorts them in different sizes. Another machine then sorts the rivets into lengths. GM men claim that this method is many times faster than hand sorting and that occasionally it has saved the company from an economic loss by solving an urgent need for a certain type of rivet whose delivery had, for one reason or another, been held up.

ANTI-VIBRATION
LITTELFUSES

Temperature changes sudden or slow, are hard on fuses. Littelfuse "Gooseneck" (illustrated below) stands guard instantly to protect fuse element from cracking or crystallizing by taking up expansion or contraction, cause of failure. Other exclusive NEW Littelfuse features are:

Elements mechanically depolarized against vibration and shock by twisting at 90°. This braces them for severest service.

Locked Cap Assembly, which seals tube against all moisture. Caps can never be loosened.

Combination with high mechanical strength for utmost resistance to fatigue.

Littelfuse "Gooseneck" Greatly enlarged
Springlike forming at right end of element shown above. Takes up contraction and expansion. Littelfuses of 5 amps., or less have a spring-link element.

LITTELFUSE INC.
First in Aircraft Fuses—Pioneers in the Industry.
4793 Ravenswood Ave., Chicago, Ill.
263 Ong St., El Monte (Los Angeles suburb) Calif.

A NEW TORQUE WRENCH

An Important Development in the Hand Tool Field

The New Livermont Torq-Snap Wrench can be used efficiently in total darkness and in noisy areas as well—inside a wing-hull or semi-dark hanger—on the flight ramp or on the field with engines running.

When the proper predetermined torque load is reached, the Torq-Snap gives both an audible "click" and a definite physical sensation which is transferred to the operator's palm. *No visual attention is necessary.* No dials or battery operated indicators are involved.

Simple in design, this new torque wrench works on the principle of spring bar deflection. The deflection in the main bar bends

a secondary spring which snaps over center when the proper load, for which the wrench has been pre-set, is reached.

The Torq-Snap was developed by the Engineering Department of Tubing Seal-Cap, Inc., for one of the largest aircraft manufacturers—and it has passed exhaustive tests. It operates within a very close tolerance and eliminates hazardous variations formerly unavoidable in vital aircraft plumbing connections.

Twelve sizes are available with open or box ends, either offset or straight. Write for complete specifications (on your firm letterhead, please).

"CLICK"

TUBING SEAL-CAP, INC.
215 W. 7th STREET, LOS ANGELES
East. Representative, 428 New Center Bldg., Detroit

...and the AIRCRAFTSMANSHIP that helps train pilots *fast!*

SALUTE THE "BOBCAT", Cessna's tough twin-engine bomber-pilot trainer—and salute the Cessna engineers who developed her. Not designed from "scratch" despite her name, this AT-17 is a startling tribute to the foresight, initiative and "stay-out-in-front" spirit of the entire Cessna organization.

For as early as 1939, Cessna had begun production of a medium-weight, high performance twin engine cabin monoplane—a ready-made answer to U.S. Army prayers for a rugged, dependable multi-engine familiarization airplane.

Thanks to the T-50 and the skilled adaptations which followed—the R.C.A.F. "Crane" and our own Army's "Bobcat"—the training of U. S. and Canadian bomber personnel was able to leap 'way ahead of schedule. Today, thousands of "Cranes" and "Bobcats" are in service helping pilots grow into eagles. You can thank Cessna for that, America—and for the ruggedness that *keeps* those trainers in service, too. With men like Cessna's engineers in your working army, you can look forward with pride and confidence to the day when you'll take to the skies in the coming "Family Car of the Air."

NAMES the U. S. must never forget

AERONCA
AIR CRUISERS
BEECH
BELL
BOEING
BOWLUS
BREWSTER
★CESSNA
COLGATE
COMMONWEALTH
CONSOLIDATED
CULVER
CURTISS-WRIGHT
DOUGLAS
FAIRCHILD
FLEETWINGS
FLETCHER
FORD
G & A AIRCRAFT
GENERAL MOTORS
GOODYEAR
GRUMMAN
HOWARD
INTERSTATE
LOCKHEED
MARTIN
McDONNELL
NORTH AMERICAN
NORTHROP
PIPER
REPUBLIC
RYAN
STEARMAN
TAYLORCRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
VULTEE
WACO

THE "NERVOUS SYSTEM" of a modern plane is a complex network of tubes, wires, cords. The pilot depends on all of them to give him command. Here at Roebling, aircraft control cables—*steel* component of that nervous system—are made with all the skill and care that aircraft controls deserve. John A. Roebling's Sons Company, Trenton, New Jersey. Branches and Warehouses in Principal Cities.

ROEBLING

*In these frequent messages, Roebling salutes each member of the aircraft industry in turn.

ROEBLING
means Control in the air

Fuel Consumption

(*Continued from page 58*)

ground operation on landing and two minutes for take-off including all runways. The power used seldom exceeds bursts of 300 h.p. and probably averages about 110 h.p. for a twin-engined transport of 25,000 lbs. gross weight. Checks made at LaGuardia Field show an average of 3 lbs. per minute fuel consumed during normal taxiing conditions for the DC-3.

D) ENGINE RUN-UP CHECK PRIOR TO TAKE-OFF: This operation is required as a final check of all functioning units of the power plant to ascertain that everything is in order prior to the take-off. Throttles are advanced individually to a specified manifold pressure and held until the ignition is checked on both magnetos and the engine r.p.m. oil pressure, fuel pressure, etc., are checked. This usually requires about eight to 12 seconds for each engine. The total consumption for an 1,100 h.p. engine run up at 30 inches manifold pressure at about 2,000 r.p.m. for 10 seconds is two pounds.

E) TAKE-OFF, INCLUDING INITIAL CLIMB: The airlines vary considerably in use of full rated take-off power on the DC-3. Most of the airlines operating engines which develop take-off power at sea level are using full allowable power on each take-off. Other airlines use 85 per cent of rated take-off power except where more is needed. The take-off power used is held until the plane is clear of all obstructions adjacent to the field or until the plane is about 50 feet in the air. This time seldom exceeds 45 seconds and normally is about 30 seconds for landplanes. Power is reduced to climbing power in steps; first, by retarding the throttles to approximately rated power position; then reducing the r.p.m. by moving the propeller controls to climbing r.p.m. position, and finally, adjusting the throttles for climbing power. The complete operation from start of take-off requires, on an average, about 60 seconds.

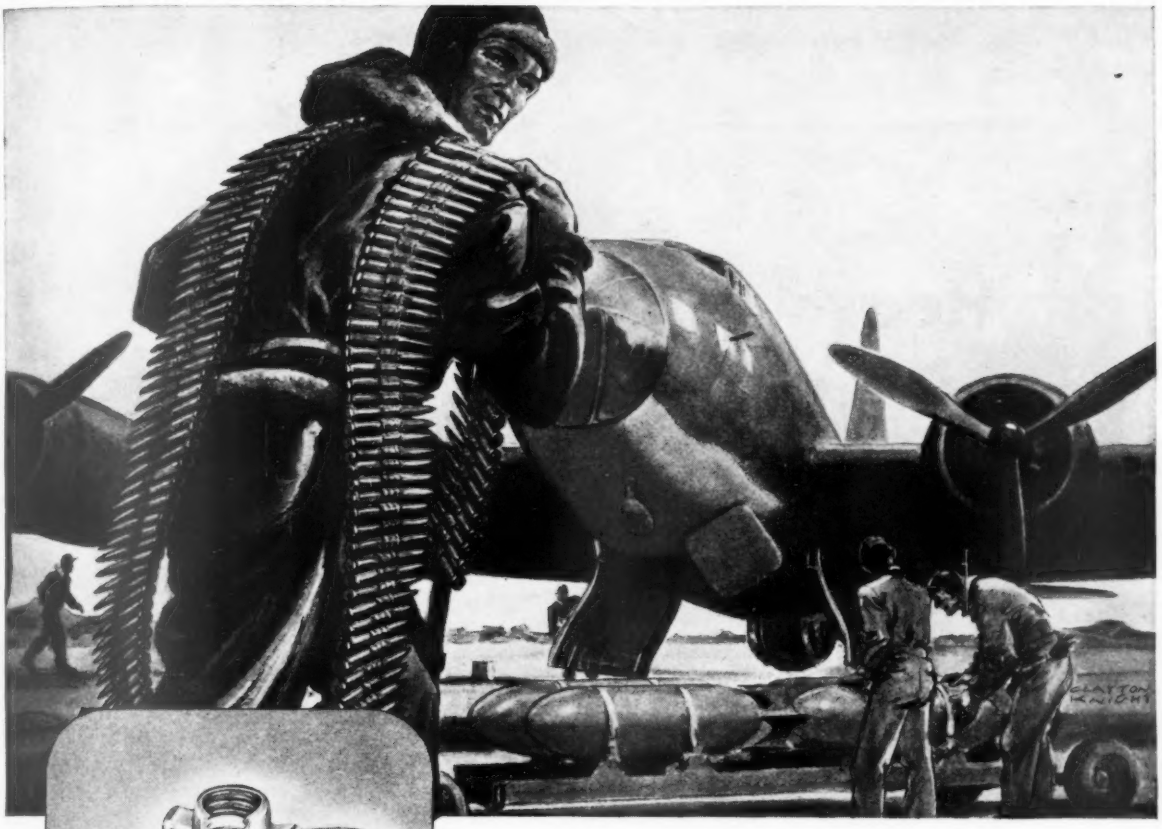
The mixture setting of the carburetors for take-off power varies considerably between airlines operating the same type of engines on the same type of fuel and with engines having the same type of cowling. Surveys indicate that take-off power mixtures vary between .72 and .81 lb./b.h.p./hr. which corresponds to .106 to .120 f/a. A very interesting fact is that some installations equipped with cowl flaps are using take-off mixture settings richer than some installations with a fixed gap cowl. All operators are losing an appreciable amount of power on take-off because of the rich mixtures used. All engine manufacturers can give accurate data obtained on dynamometer tests so that the operator should be aware of the approximate penalty on take-off power incurred by the use of any given mixture. It might be added here that prior to the use of torquemeters for airplane performance testing, results in take-off and rated power performance were very erratic and flight analysts were under the necessity of using an average of a large number of tests in order to obtain a reasonably accurate result. The use of torquemeters, analyzers and flowmeters made it possible to duplicate (with reasonable accuracy) any test made at an earlier date. On account of overheating with lean mixtures and power loss with rich mixtures, it is necessary to carefully control the mixtures of all carburetors in operation in order to obtain uniform take-off performance from all planes in the fleet.

Because the power varies considerably from the start of the take-off until climbing power has been established, the whole sequence has been treated as one operation in determining the total amount of fuel consumed during the take-off operation. An average of several tests on a DC-3 equipped with two 1,100 h.p. engines having carburetors set at .112 f/a, shows that the average take-off consumes 25.5 lbs. or 4.2 gallons of fuel. In estimating the required fuel capacities, operations departments of some airlines use a round figure of 10 gallons for all ground operations and take-off. From the foregoing analysis, points A, C, D and E total 36 lbs. or six gallons. It would appear that 10 gallons is allowing a very adequate margin for reserve and for additional ground holding in all weather where engines may be idled for as much as 40 minutes prior to take-off. Under fair weather conditions, the payload of the ship could be stepped up about 24 lbs. if this round figure of 10 gallons were reduced to six gallons total consumption between the time the tanks are topped off prior to flight until the power is reduced for cruising climb after take-off.

F) CRUISE CLIMB: Most of the airlines allow more power for cruising climb than for cruising level operation as this phase of the operation extends over a shorter time and it is desired to get the plane to cruising altitude in the shortest reasonable time. Allowable climbing power varies from 65 per cent to 70 per cent of maximum engine take-off power among the airlines. Climbing airspeeds used vary between 110 and 125 m.p.h. but normally are about 65 per cent of the cruising speed. This reduced speed decreases the cooling blast for the engine and consequently requires additional cooling by use of rich mixtures. A survey of the airlines shows that climbing mixtures vary between .54 and .59 lb./b.h.p./hr. which corresponds to .082 to .090 f/a. In general, it appears that users of cowl flaps can use slightly leaner mixtures for climbing operation than the users of installations with fixed gap cowls.

On routes where the average flight is about 45 minutes, block to block, and where cruising altitudes are relatively low, the cruising climb operation offers little opportunity for fuel savings, as frequently the climb is completed within a few minutes after take-off. However, on the longer schedules where the climb continues for 15 to 20 minutes, climbing consumptions offer good possibilities for reducing yearly consumptions of fuel. Looking further into the future towards planes which will fly at altitudes above 20,000 feet, climbing consumptions will

(*Continued on page 124*)



Saver of Precious Metal

Because Boots Self-Locking Nuts are lighter, they save hundreds of tons of strategic metal. The Anchor Nut (shown in cross-section above) is the type of Boots Nut most commonly used on military planes. It operates on the familiar Boots self-locking principle. The threads of the top, locking section are slightly out of phase with those of the lower, load-carrying section. When the bolt engages the locking section, a constant pressure is established which prevents any loosening due to vibration.

Here's More Fire-Power to You, Sergeant!

The lighter the plane, the greater can be its fire-power. Every pound saved in airplane construction therefore becomes a vital factor in winning the war.

Planes of all types, from the greatest four-motored bomber down to the small pursuit or trainer, are made with Boots all metal, self-locking nuts. On a heavy bomber, this means a saving of more than sixty pounds—enough for 200 rounds of .50 calibre machine gun bullets.

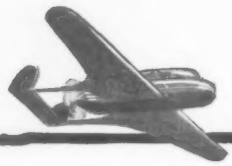
Boots all-metal nuts are not only lighter, but literally "outlast the plane."

Specially developed for motor application, the new Boots "Rol-Top" Self-Locking Nut is winning a wide acceptance among engine manufacturers.

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT



Heard this one about the traveling salesman?

It's about a post-war traveling salesman who made calls on customers in six different towns in one day—and the one he saw at 4:30 in the afternoon was 600 miles away from the city where he ate breakfast! After the war, such lightning covering of sales territories will be commonplace. Any salesman will be able to do it—flying in his own plane!

That plane may be a roadable, folding-wing monoplane; it may be a helicopter; or perhaps a type as yet unheard of. But whatever its shape, chances are it will be powered by a light, economical Franklin engine. For 43 years the genius of Franklin engineers has produced ever-finer air-cooled engines. Franklins were used by every major producer of light planes before the war. Today they are serving in Army and Navy warplanes. And already Franklin engines have powered the leading experimental types—the forerunners of the private-owner planes soon to come. Look for Franklin power in *your* post-war plane.

AIRCOOLED MOTORS CORPORATION
SYRACUSE, NEW YORK

Franklin
FINE AIRCRAFT ENGINES

Tunisian Take-off

A "Marauder" gets away on AEROLS*

Far superior to similar Axis planes, Martin's B-26 bomber, called the "Marauder," has established an enviable record in the North Africa campaign.

Equipped with Aerols, the "Marauder" takes off and lands readily on the unfavorable terrain of Tunisia.

In today's global war, Aerols are also serving on every other front, on every type of plane. From the steppes of Russia to emergency fields in the South Sea Islands, Aerols are contributing to the achievements of American aircraft.

THE CLEVELAND PNEUMATIC TOOL COMPANY
AIRCRAFT DIVISION • • **CLEVELAND, OHIO**

Also Manufacturers of Cleco pneumatic tools for the aircraft and general industry, Cleco sheetholders, Cle-Air shock absorbers for trucks and buses, and Cleveland rock drills for mining and construction work.

AEROLS

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

WANT TO PUNISH an airplane? Turn it over to a bunch of student fliers. Let them practice take-offs and landings—six an hour for a couple of thousand hours! Re-design it for still greater efficiency. Then give it to the boys again. Repeat this process with several ships, and you'll end up with the makings of a good primary trainer!

That, in brief, is the story of the Ryan PT-22, currently training thousands of pilots, without a single serious structural failure! Because of its peacetime concentration on building trainers and using them in its own flying school, Ryan could proceed under war conditions to immediate mass production of trainers of *proved* merit.

Ryan went on from there to develop its recent PT-25 plastic-bonded plywood trainer, its YO-51 "Dragonfly" liaison plane . . . to become, through this development of *specific* planes for *specific* wartime jobs, one of the "names we must never forget" — one of America's permanent factors in the production of planes for war and for peace!

NAMES the U. S. must never forget

AERONCA
AIR CRUISERS
BEECH
BELL
BOEING
BOWLUS
BREWSTER
CESSNA
COLGATE
COMMONWEALTH
CONSOLIDATED
CULVER
CURTISS-WRIGHT
DOUGLAS
FAIRCHILD
FLEETWINGS
FLETCHER
FORD
G & A AIRCRAFT
GENERAL MOTORS
GOODYEAR
GRUMMAN
HOWARD
INTERSTATE
LOCKHEED
MARTIN
McDONNELL
NORTH AMERICAN
NORTHROP
PIPER
REPUBLIC
★ RYAN
STEARMAN
TAYLORCRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
VULTEE
WACO

What's the best airplane? We hope we've helped show that there "aint no such animal", that each plane is a machine designed to do a *specific* job. The same thing applies to parts of a plane too—there's no single most important part. But the combination—the team of parts—can be no better than the parts themselves. Here at Roebling, we build aircraft control cord as though it were the *only* vital part. John A. Roebling's Sons Company, Trenton, New Jersey. Branches and Warehouses in Principal Cities.

JAR ROEBLING

*In these frequent messages, Roebling salutes each member of the aircraft industry in turn.

ROEBLING

means Control in the air

(*Continued from page* 120)

offer even greater opportunities for improving the general fuel economy of the airline.

Climbing mixtures are always based on the requirements of the hottest cylinder. Cylinder head temperature distributions nearly always vary considerably from head temperature distribution in cruising level flight. Usually, the top cylinders of a radial air-cooled engine are hottest in climbing operation. If suitable cowling can be obtained to effect better cooling of the top cylinders in climb, it will be possible to lean climbing mixtures and effect a substantial saving in fuel consumption during climb.

G) CRUISE LEVEL AND DESCENT: Since cruising level flight and the descent are usually made at the same power, they will be dealt with under the same heading. These phases of the operation offer the greatest possibilities for an over-all savings in fuel consumptions. Cruising level and descent comprise from 60 per cent to 80 per cent of all airline engine operation and consequently more time and effort have been expended on obtaining economical consumptions for this phase of engine operation than for any of the others heretofore mentioned.

H) ENGINE IDLING: Engine idling consumptions in pounds per minute prove to be so small in quantity that slight allowances have been made for this quantity in the taxiing consumptions and engine run up consumptions. The one case where engine idling amounts to an appreciable figure is the infrequent occurrence where a plane is held for sometimes as much as 45 minutes in thick weather, awaiting its turn to take off from the airport of departure. The airlines usually allow about 10 gallons extra in the tanks for departure when this condition is anticipated.

I) PROPELLER DYNAMIC BALANCING: Another item of fuel consumption that comes into the over-all picture is that consumed in dynamic balancing of propellers. This operation is made only on engine and propeller installations with 3:2, 16:9, and 2:1 gear ratios. The operation is conducted once or twice in the engine overhaul period and consumes on an average about 25 gallons for balancing both propellers on the DC-3.

There are two methods being used at the present time by the airlines for adjusting carburetor mixtures in flight. The first is by manual adjustment of mixtures to the desired fuel air ratio suitable for the power being used and the airspeed of the particular flight. The second method is by automatic mixture adjustment by use of a load, temperature and altitude compensating carburetor. This first method has the advantage of being sufficiently flexible so that the pilot can adjust the mixtures to the particular conditions of flight and to the needs of the engine for cooling as regards cylinder head temperatures. This method requires some attention by the pilots to adjust the mixtures for the varying conditions of flight in order to obtain the desired minimum fuel consumption. With two pilots in the cockpit of a twin-engined transport, this method has worked out very well and has resulted in a reasonable average yearly fuel consumption. Prior to the use of constant speed propellers, the fixed pitch or two-position propeller gave a rough indication for mixture setting by carefully noting the change in r.p.m. in steady flight at any given altitude of the airplane as the mixture was leaned out from full rich and also by keeping cylinder heads close to desired temperatures. When constant speed propellers came into use, this method was no longer usable and the Cambridge analyzer was adopted for an indicator of carburetor mixture settings.

(*To be concluded next month*)

Another Record Falls

RECORDS don't stand up for long today when airplanes are being developed faster and being used more than ever before. Recently another record was broken—Capt. Joseph H. Hart, Jr., a Pan American Airways master pilot, completed 12 crossings of the Atlantic in nine days, 15 hours and 40 minutes. The previous record, also made by Hart, was six trips in a little over nine days.

"Passengers and cargo had to be carried and we did it," explained the stocky, 35-year-old pilot. "All the hops were made without incident . . . I can't give too much credit to my crew, the mechanics who worked on the *Clippers* and the men who loaded them so quickly—they're the ones who made the record possible."

The route of his trips covered three continents leaving from LaGuardia Field and ending in—Europe. Perhaps the captain's flight set a commercial record, but long and record breaking flights are being made by the Army's Air Transport Command and other military and civilian pilots whose deeds must remain a guarded military secret for the duration of the war.

RAF Slang

THE boys of the RAF, in their odd moments of leisure, create slang. Here are the latest additions to the British Airmen's "Slangtionary":

"A black" ..... something badly done
"bombphleteers.pamphlet dropping flyers
"to be browned off" ..... fed up
"in the drink" ..... down at sea
"get cracking" ..... get going
"office" ..... cockpit
"pulpit" ..... cockpit
"play pussy" ..... hide in clouds
"quick squirt" .. short machine gun burst
"sausage machine" ..... pom-pom gun
"shot down in flames" . severe reprimand
"stationmaster" ..... C.O. of station
"tee up" ..... get ready
"touch bottom" ..... to crash

CAB Appointee

JESSE W. LANKFORD has become director of the CAB's Safety Board. He replaces Jerome Lederer, who resigned to become executive assistant, Airline War Training Institute.

The Ever-Present

CO-PILOT
of American Fliers

The thorough instruction received as a fledgling is the American flier's unseen co-pilot on every flight. The accumulated skills and experience of seasoned flight teachers are transferred to his brain and muscles. When he takes to the air, it's with a highly developed flight sense, well on the way to mastery of any situation, any emergency.

Co-operating closely with the U. S. Army Air Corps, Anderson Air Activities instructors are training fighter and bomber pilots for service . . . imparting to cadets the superior flying skills that make American fliers the scourge of the Axis and bring them back to fight again.

The qualifications of Anderson civilian instructors for this vital work are not only a thorough knowledge of *what* to teach but the much rarer gift of knowing *how* to teach.

Gilbert Anderson

ANDERSON *Air Activities*

Address Correspondence to ANDERSON AIR ACTIVITIES, Chester Field McBride, Mo. Home Base: General Mitchell Field—Cudahy, Wisc.
Branches at Fond du Lac and Antigo, Wisc.

CONTRACTORS TO THE U. S. ARMY AIR FORCES

Check LYON Facilities FOR FAST PRODUCTION OF AIRCRAFT PARTS IN ALUMINUM AND STEEL

✓Class A Welders used exclusively for welding Aluminum and 40/30 Cromolley Steel.

✓Welders trained in our own welders' school.

✓750-ton Hydraulic Press for production of large or small parts.

✓Sciaky Welders for fast, accurate welding of parts under exact pressure and temperature control.

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✓Full complement of modern auxiliary tools includes:

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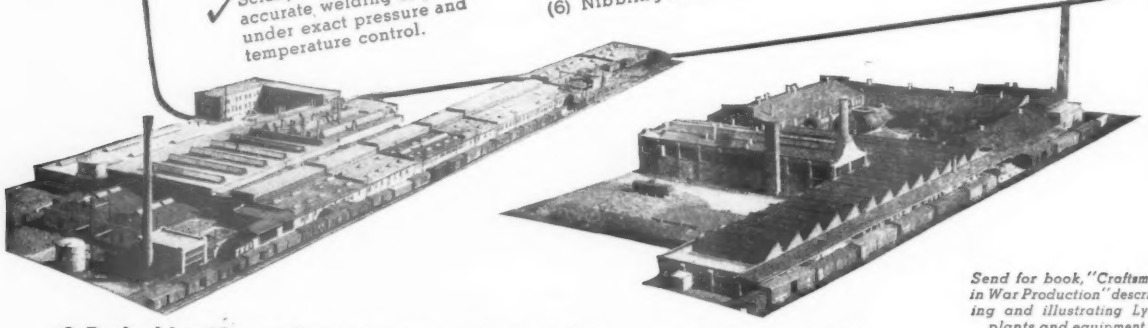
✓Complete equipment and skilled manpower to produce dies, fixtures, jigs to meet contract requirements.



● Backed by 43 years' experience in fabricating sheet metal . . . over two years' on special war products . . . our new Aircraft Division offers production facilities to aircraft manufacturers for increasing output of aluminum and steel parts and sub-assemblies.

This modern, completely equipped Aircraft Division is supervised by men specially trained in aircraft plants. Products now being manufactured include Ailerons, Rudders, Elevators and Ammunition Boxes in *aluminum* . . . Vertical Fins, Stabilizers, Elevators and Carburetor Intake Valves of *Cromolley Steel.* Other types of aircraft parts within the range of our organization are indicated by partial check list of facilities above.

Phone, wire or write for detailed information on Lyon facilities applicable to your aircraft parts requirements.

Send for book, "Craftsmen in War Production" describing and illustrating Lyon plants and equipment.

LYON METAL PRODUCTS, INCORPORATED

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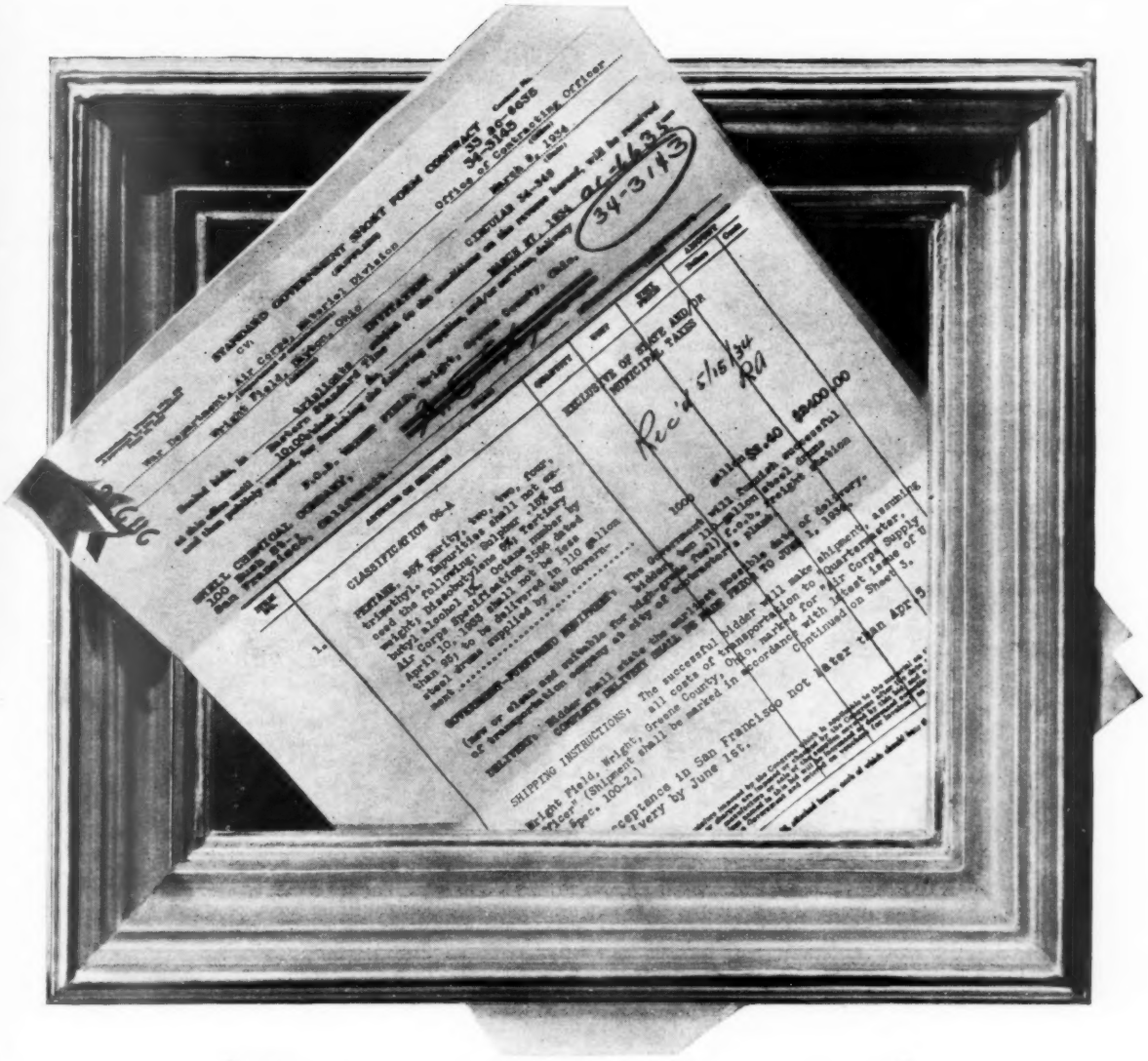
LYON METAL PRODUCTS, INCORPORATED



"YOU OUGHT TO FRAME IT"

IN RESPONSE to the above historic order for fuel "not less than 95-octane," Shell's Research Laboratories did the "impossible" —supplied the U. S. Army Air Corps with 1,000 gals. of Iso-octane, to make the first 100-octane aviation fuel ever produced in a commercial quantity. Fuel that has given our air arm added punch, extra reach.

Although the quantity of 100-octane fuel turned out by all American refiners has been greatly multiplied since Pearl Harbor, Shell is maintaining its former position in the total production.

In fact, the majority of the country's leading plane and engine manufacturers are using Shell Aviation Fuels. Preference for Shell Aviation Products prevails among many aviation training schools, transport lines and airports.

Farsighted airport operators will find Shell's wartime popularity a profitable peacetime asset.

AVIATION FUELS SHELL AEROSHELL OILS

Tennessee's Airwomen

(*Continued from page 47*)

of Omlie and McDonald, they shook their heads.

"Something is bound to break loose," they commented.

What did break loose was a plan to have 10 women pilots descend on Nashville to begin postgraduate work in the theory and practice of teaching flying.

Phoebe Omlie, echoing her own and McDonald's sentiments, stated about the plan:

"We need a new appraisal of women in war, particularly in aviation. The whole program of women in war work always gets distorted by excess publicity, until you can't see the jobs for the women, uniforms and window dressing. I'm eager to add here that it is not the fault of the women, either. The first women in the factories had to smear grease on their faces and pull their hair down to satisfy the art editors of the newspapers. Later, as each new and different job for women opened up, the photographers dressed it up and the writers elaborated upon it, until we hardly know today what the important jobs are.

"Naturally, the dashing, uniformed, woman pilot of a roaring warplane is going to get more attention (and photography) than her flight instructor sister, just as the uniformed volunteer gets more publicity than her coveralled sister at the factory workbench. Just as naturally, however, women are finding their proper places as instructors, the position women have filled better than men for generations."

To make sure that they weren't talking through their hats, they first sent letters of inquiry to flight school operators throughout the south, asking if they would use women instructors.

The answers were unanimous:

"Give us women instructors who are qualified and we'll cry for more."

Intending at first to pick only women from Tennessee, Mrs. Omlie accepted applications from neighboring states "just in case."

In setting up standards by which to choose the final 10, Mrs. Omlie worked on the theory that the old gripe about "the low ratio of good pilots to the number of women trained" was partially true, but only because no systematic method of selecting had been used before.

Mrs. Omlie and McDonald appointed a selection committee composed of an educator, a psychologist from the Army Air Forces classification center, members of the State Bureau, a housewife and a flight instructor to take care of flight checks.

The applications required that the pilots be single or, if married, that their husbands be in active military service; that they hold a private license or better, preferably with over 120 hours of flying time, and that they agree to instruct wherever or whenever the Bureau decided to place them.

In return the Bureau promised them 62 hours of flying, 216 hours of ground school instruction, 162 hours of flight instructors ground school, a hard eight hours of work a day for six days a week for 12 weeks, uniforms, food and an enormous old southern colonial house for a dormitory.

On September 13, 15 of the applicants came to Nashville to be interviewed by the selection committee and receive flight checks.

When the sun went down that day, the last weary girl—her head whirling with such questions from a psychologist as, "Tell us how you would bake a cake" and such orders from a flight check pilot as, "Do me a two-turn right spin"—crawled out of a plane at Gillespie Airways. The next day the committee announced that only six of the girls had passed the stiff examination. That left four needed to go to meet the pre-determined quota.

The Omlie-McDonald pair then took the 220 "just in case" applications from other states and spent a week finding four women pilots who could qualify.

The immediate problem was one of housing and staffing a house. A vast old colonial home sat on the hill near Gillespie Airways, where the flight school was to operate. Property of a southerner whose family fortune disappeared with slavery, the house offered a piano with a honky-tonk tone—a fireplace in every room, dirt in every closet and not much else.

Mrs. Omlie had less than a week to clean and furnish the place. Help was hard to get and equipment harder. Up went the Omlie shirt sleeves and down went the Omlie knees as she dug into the junk in closets and corners and helped the slow paper hangers slap on paste.

When the first girls arrived they found the house not quite finished and Mrs. Omlie still on hands and knees. She looked up and grinned through the grime:

"See what I mean, girls? There's no glamour in this business."

Came the problem of bedding and beds. Priority officials, knowing little of the program, said, "No beds." Finally after wires to Washington and many visits to merchants who didn't have anything and couldn't get anything, she found one who said:

"Come on down, but you won't like what I've got." What he had turned out to be some plain wooden cots with more sag than spring. Mrs. Omlie took them.

Blankets, the storekeepers said, were out of the question. Putting on an almost house to house canvass Phoebe

FLYING

"My parachute failed to open! . . . The burning plane is rushing toward me! . . . What will I do? Can I save myself? Tune in tomorrow at the same time! . . ."

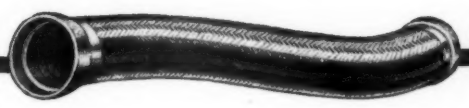
BREEZE SHIELDING CONDUIT

... Tough, Flexible, Long-lived

BREEZE Flexible Shielding Conduit is being produced in ever-increasing quantities for the fighting forces of the United Nations. Used in conjunction with Breeze Fittings, this Flexible Conduit is designed to meet varied shielding requirements in installations ranging from PT boats to aircraft. From its background of years of experience in the field, Breeze has acquired the knowledge to solve shielding problems of all kinds — knowledge which is reflected today in the high standards of Breeze design and manufacture.

BREEZE MARK

BREEZE CORPORATIONS, INC. • NEWARK, NEW JERSEY



learned that the state prison had some extra blankets.

"For fear a crime wave would break, I worked fast," she said, "and got the blankets."

After that it was simple to unearth a matron with "three sons in the service and a desire to help," a competent secretary, a "Gone with the Wind" Negro cook named Lizzie and a Negro houseboy called Jim.

Into this southern setting came the modern, business-like young women—bringing compasses and protractors, flight computers and log books. Walls that once echoed to flirtatious laughter now resounded to wails of, "Gosh my eights were terrible today!"

Before the school got underway, the operating team ran into the very shortage they were trying to overcome— It was impossible to hire an instructor who could teach all the ground school classes. They had to assemble a complete faculty which would cover the entire curriculum. Whereas it was impossible to hire a man who had a thorough knowledge of meteorology, aircraft, navigation, engines and Civil Air Regulations, the girls on graduation were masters and competent teachers of these subjects.

The group can be used as a yard stick for women pilots. It showed that ages vary from 20 to 33 years; that average height is 5 ft. 4 in. and that good looks are above average with blue eyes and brown hair predominant. Two are married and all but one of them graduated from CPTP courses.

At 6:45 in the morning the clang, clang of the old plantation bell in the yard awakened them. In 15 minutes they were on the dewy lawn ready for morning calisthenics, led by 20-year-old Jennie Lou Gower, former assembly line inspector at the Nashville division of Vultee Aircraft, Inc.

After 15 minutes under her direction they were ready for breakfast, for which they were allowed 45 minutes.

Another 15 minutes was devoted to assembling books and marching to the field. There were one or two laggards in getting started. Capt. Elizabeth Hall reprimanded them. The girls discipline themselves. A first captain is appointed who in turn appoints a co-captain. The captain serves for a week when the co-captain succeeds her and names another co-captain.

Marching in line, the girls are under the command of Mary Elizabeth Pigg of Nashville. Mary is an old hand at drilling, having acquired 30 hours of military drill with the Civil Air Patrol.

Arriving at the field, 45 minutes was allotted to class work on aerodynamics. Then came a 15 minute recess and another 45 minutes of classroom work in meteorology. From 10 to 11:30 they scattered, some in the shops; some on the line, gassing ships; some in the offices or flight clearance desks. One girl was flying dual and another solo. The flying was done mostly in 60 h.p. Aeroncas.

From 11:30 to one o'clock it was back to the dormitory again for a lunch consisting of as many yellow vegetables as possible (for the eyes) and all the milk they could drink. In addition they could drink milk at any time during the day.

The afternoon schedule followed the same pattern with another alternate flight and shop-work period from one to three o'clock; class work on engines and navigation until five o'clock; recreation period from five to six o'clock; dinner from six to seven, and study from seven until nine with lights out at 10 o'clock.

Once a week they had a check-up by a doctor. On Saturday nights and Sundays they were free to go where they pleased as long as they were back by "lights-out" time on Sunday night.

This program—entailing the menial labor of hoisting a gas hose, sanding old dope off wings, running daily line checks on aircraft, tearing motors down—had no room for glamour girls. These women had the good judgment to use their rest hour for group relaxation and fun.

Sitting on the end of a long couch before the fireplace, Dorothy Swain, of Asheville, N. C., drew the strains of "Sweet Sue" from her guitar. She learned about aircraft at the Piper Aircraft Corporation in Lock Haven, Pa., where she ferried planes.

Serious-eyed Cora McDonald sat dreaming in a corner. Holder of a B.S. degree in aeronautical engineering from Mississippi State, she was formerly an aeronautical engineer at Bristol Aircraft Company in Bristol, Tenn. She learned to fly in a CPT program at Mississippi State.

Mrs. Elizabeth Hall of Lexington, Ky., was born in Landour, Mussoorie, India. She came to America only eight years ago. She had never seen an airplane until she came to America. When she entered the instructor's school her log book showed 150 hours.

In a lull in the music, a pert little girl opened her mouth and her eyes grew big. Emmy Whittington Hall was off on one of her nightly ghost tales. Emmy is from Hot Springs, Ark.

Mrs. Helen Johnston, whose flying husband is Maj. Lyle F. Johnston, commanding officer of the 127th Observation Squadron, Tullahoma, Tenn., sat quietly. She has over 300 hours in the air.

Martha Childress of Columbia, Tenn., was another CPT trainee. With a B.A. degree at Vanderbilt University she took CPT training there. Later she married and is now Mrs. J. D. Kooken.

Lucille Biggs Kuntz of Martin, Tenn., shook her red curls calmly. A graduate of the University of Tennessee, she taught school and helped run Gull Dove Airways at Martin.

Jennie Lou Gower, the baby of the group, attended Cumberland University. Margaret Wakefield graduated from Van-

FLYING

"That's what I said! My parachute didn't open!"

The skin of freedom's teeth

When free America first struck back at totalityranny, Boeing Flying Fortresses* put teeth in our aerial offensive . . . smiting the enemy with death from the substratosphere.

In the photograph above, you see the aluminum "skin" that covers the wings of the Boeing B-17. To speed the output of the thirty-two-ton Fortresses, aluminum alloy sheets were needed of greater dimension than it is practical to manufacture.

On the machine pictured above, developed by Boeing tooling engineers, standard aluminum alloy stock is automatically spot-welded into "super-sheets" up to 14 feet wide and any desired length. Many times faster than flush-riveting, the Boeing automatic feed spot-welding tables make 65 controlled welds a minute, enabling Boeing to meet the extremely high U. S. Army requirements while maintaining quantity production. And the elimination of rivets reduces "drag" and increases speed in flight.

This is merely one of more than 100,000 special tools and templates developed by Boeing for the faster production of the Flying Fortress. Like many other Boeing-developed tools, it has been widely adopted by major aircraft manufacturers throughout America.

And tooling is but one of more than *twenty-five* different fields of engineering activity at Boeing . . . fields which might seem, to the uninitiated, a far cry from Flying Fortresses, Stratoliners,* globe-girdling Clippers and other Boeing-designed and Boeing-built airplanes.

It is this diverse skill and experience in manufacturing, tooling, engineering research and design which will some day make the phrase "Built by Boeing" a hall-mark of better products for free men in a better world.

DESIGNERS OF THE FLYING FORTRESS • THE STRATOLINER • PAN AMERICAN CLIPPERS **BOEING**

*THE TERMS "FLYING FORTRESS" AND "STRATOLINER" ARE REGISTERED BOEING TRADE-MARKS

derbilt University. She was a teacher.

Only one near-catastrophe threatened the venture. That was when part of the Second Army, maneuvering in Tennessee, camped on the hill next door. And, shades of Icarus!, the dorm didn't have shades. Priorities came across in a hurry.

Phoebe Fairgrave Omlie needs little introduction to either the aviation world or to laymen. Her exploits as a parachute jumper on her fifth ride in a plane, as a wing walker for Fox Moving Picture Company in the "Perils of Pauline," as a pilot, as the wife of Vernon Omlie, who taught her to fly, and as the subsequent partner in one of the greatest aviation marriages of all time, are history.

Vernon and Phoebe flew wherever they could find a field big enough in which to sit down. Prophets and preachers in a day which thought of aviation as "barnstorming tomfoolishness," they flew and went broke and flew again. Even as early as 1926, they tried to put aviation ground school instruction into the high schools of Tennessee. Only now has Phoebe seen that dream come true. Vernon was killed in a plane crash in 1936.

Percy McDonald is an attorney in Memphis. If there is a non-paying job in the community, he is sure to hold it. His interest in aviation has always been on a nonprofit basis. He helped get the appropriation for the present municipal airport at Memphis. Largely through his efforts the state bureau now regularly makes allotments to improve the airports of the state.

Last year he and Col. Herbert Fox, director of the Bureau of Aeronautics, put aviation into Tennessee's public schools by buying 10,000 model kits and distributing them to the schools. This gave Tennessee children a head start when it came to building models for the Navy Department.

As for the future of the trainees in the Research School, they were asked for long before they finished training and passed tests for instructor's rating. One school in Florida asked for all of them, but was told that three were already placed.

The Tennessee Bureau of Aeronautics has now decided that their next service to the war effort, and to the promotion of aviation, should be to urge a nationwide women's instructor training program, based on their experience. They have therefore urged the Appropriation Committee of the Senate to include an item of $2,500,000 in the 1943 Supplementary Appropriation for the training of 500 other women pilots throughout the country within the next six months.

END

Dead Reckoning Navigation

(*Continued from page* 66)

course so that the plane can be climbed to altitude and settled down on course.

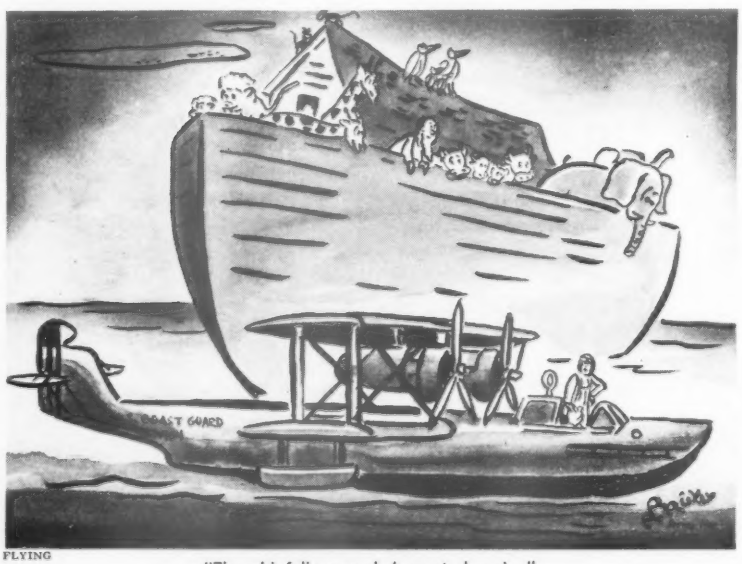
We are on a typical flight from Columbus to Cincinnati, O. After take off from Port Columbus and climb to desired altitude, we fly the plane directly over the point of departure, which is a race track near Grove City, and head it along the compass heading, 237°, which is shown on the card. This compass heading will hold us on course—*if* there is not drift. At the point of departure, we record the time in the "depart" column and start the stop-watch if one is available. For the next few minutes we just concentrate on flying a steady compass heading and maintaining speed and altitude. We note by checking land marks passed, whether drift is right or left of the course and about how much. The plane seems to be following the 9° right drift line so that line is the track. We record the amount of the drift in the drift column of the card, and figure out what the new compass heading will be after we alter course back to the left 18°, or twice the amount of the drift. Our new compass heading will be 219° in order to get back to the desired track. We enter this item on the card on the A/C-S/C line in the "comp" column. After three or four minutes more have elapsed, we notice that we'll pass over the town of Range, O., and decide to alter course at that point. When exactly over this landmark, we stop the stop-watch, alter course 18° to the left, and record the elapsed time and the time of departure from A/C. We are now at the point A/C (alter course) on the card and chart. We are careful to alter course to the left if drift has been right.

When we are settled down on this new heading after altering course, we can be sure that it will carry us back to the intended course in 10 or 15 minutes, and we have an opportunity to compute the ground speed of the first leg. The elapsed time is more accurate if taken from the stop-watch than if taken from the "depart" times as recorded on the card. We should note this time to the quarter of a minute. We measure the distance on the chart from "dep" to "A/C," find it to be 21 miles, and record it in the column provided. Then, with a speed-time-distance computer, we figure out the ground speed. With this done, we have one side (side b, Figure 1) of the triangle of velocities accurately determined. So with the aid of a navigational computer, the direction and velocity of the wind can be determined. First, however, it is necessary to put the true heading and true airspeed on the computer. The altitude and temperature are recorded on the card and the calibrated airspeed is corrected for these two values to give the true airspeed. The true heading is already on the card for it was the true heading steered, so with the two sides of the triangle accurately determined, we can compute the third side —the wind. With a knowledge of the wind force and direction, the heading to steer in order to remain on course can be figured with the computer.

During the time that we have used for these computations, the plane will probably have gotten back to the intended course which is at Milledgeville, O., so we will *set course*. This point is recorded on the card along the line labeled S/C. After setting course, the plane should follow the intended course on to Cincinnati almost exactly. The first try at this system may be disappointing, but after a few times the accuracy will be amazing.

In case no computer has been used, the course must be set using the drift observed in the flight from "dep-A/C." In this case the direction and velocity of the wind is not known, but the drift in degrees is known. Inasmuch as the drift angle does not always equal the wind correction angle, the plane may not stay exactly on the intended course after setting course.

END



FLYING

"The old fellow sez he's neutral and all he wants to know is if the flood is over."

Mother's Day... Sunday, May 9th

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AOPA NEWS

The Aircraft Owners and Pilots Association, with Service Headquarters in the Michigan Square Building, Chicago, Ill., is a non-profit organization formed and composed of non-scheduled aircraft pilots and/or owners exclusively. The AOPA operates with a full-time professional staff and is the largest group of civilian pilots in the world. The views and statements of opinion contained in this column are those of the Aircraft Owners and Pilots Association and not necessarily those of FLYING. This column is edited by the staff of AOPA for its members and other interested parties. Special releases of a more confidential nature are additionally sent each month to all registered members.

A GENERAL call to arms was sounded last month by the AOPA to all non-scheduled pilots and friends of aviation. The AOPA staff is vigorously opposing a number of bills proposed in the legislative halls of several states.

It is truly an epidemic of legislationitis. And it is not, in our opinion, good legislation but some more of the create-a-job, tax-the-pilot, obstruct-aviation variety of perennials that seem to pop up every spring.

Now that a great majority of young America has gone across the seas, it is perhaps the idea of many sponsoring groups that they can railroad these bills through the state legislatures with little or any opposition. AOPA is dedicated to the proposition of voicing the opinions of its membership, whether they are here in the country to represent themselves or whether they are abroad fighting under the country's flag.

We believe the sponsors of many of these bills should be shamed for even proposing them at this time. But it is not enough to shake our finger at them and utter the word "unpatriotic." Powerful cliques are busily engaged in the business of bringing new state aeronautical commissions into being, creating or increasing state gas taxes, creating "pork barrel" state regulatory organizations which merely serve to duplicate the work now done by the Civil Aeronautics Administration (and greatly confuse the whole issue), but worse than all these groups are proposing heavy yearly taxes (some call them "fees") against pilots and aircraft. An example of the latter is H.B. 404 in the State of Iowa which, in the opinion of the AOPA, if passed would usher private aviation back into the dark ages.

A more complete discussion of this subject will appear in the AOPA Membership Bulletin. All readers, whether AOPA pilots or just plain aviation enthusiasts, are urged to check on their own pending state legislation and to co-operate with AOPA in stamping out all traces of this threatened scourge.

The Big Two

The two principal pillars of non-scheduled aviation today are represented in the Civil Air Patrol and the CAA War Training Service, although it must not be forgotten that thousands of airplanes still are being operated throughout the U. S. by individual corporations and owners, many of whom have been obliged to use "private" aircraft in conjunction with their travels and in furthering the war effort, due to the increasing difficulty in obtaining space in regular airliners.

A few weeks ago we expressed concern over rumors regarding the Civil Air Patrol to the effect that it might be "officially retired." We expressed hope at that time that such retirement might take the form of a reorganization and revamping to place CAP more directly under military control.

It now has been admitted by reliable Government sources that a reorganization plan which would place CAP under the Army is in close prospect. Members will be kept informed of these developments as they transpire through the medium of the monthly AOPA Membership Bulletin or a special edition of "Cockpit Clatter."

Lists are now being published indicating where the new Navy program and the Army cadet and reservist programs of the WTS will be located. This pattern has developed with very few minor exceptions along the lines prophesied by AOPA. It has been tough going for small operators whose programs have not been renewed and who have, therefore, been obliged either to sell out or to consolidate into larger units. Chief benefits have been clarification of priorities for aircraft and engine parts and a stabilization of the WTS program. It is hoped that careful training curriculums will be established and that the CAA War Training Service will not jeopardize its good start by overstaffing its headquarters at the expense of field organizations.

Des Moines, Ia., Unit combats unfavorable state legislation. Left to right are Dr. S. M. Sawdey, June Braun, Morris Mandelbaum, Jr., John P. Jones and C. Edwin Helm.

Des Moines AOPA Unit Rejuvenated

Sparked into action by recent introduction of unfavorable state legislation in Iowa, one of AOPA's oldest units has again sprung into action under the able leadership of **C. Edwin Helm**, its president.

It is truly indicative of the American spirit to see AOPA groups throughout the country respond to a call to action. It is reassuring to see their spontaneous desire to maintain their priceless American heritage.

We picture herewith (with our congratulations) a portion of the Des Moines AOPA Unit as of last summer. AOPA pilots everywhere are grateful for the recent activities of the Des Moines Unit in vigorously denouncing detrimental aviation legislation in their state.

Members in Service

Last month's AOPA's Members in Service scroll rose way above the 500 mark. We are proud of this "scroll of honor." We are making every effort to have it complete. It is again published this month in its entirety in the AOPA Membership Bulletin. If you know of an AOPA pilot in the military services of the U. S. or an allied nation, you are urged to forward the information to the AOPA National Service Office so that proper recognition may be extended.

END

"THUNDERBOLTS"... Across the field and out of sight in a matter of seconds, *Republic P-47* squadrons, in thunderous flight, streak to battle. Such speed and power mark a new epoch in high-altitude fighter combat . . . portend the final purge from the skies of the emblems of piracy.

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Lightnings in Africa

(*Continued from page 25*)

left engine was knocked out by an Italian soldier firing a tommy-gun on the ground. Both Lusk and Carlton had to limp home with Lieutenant Butler watching out for them and navigating at the same time. But the boys got back with their damaged ships intact.

Another example of single-engine performance by the P-38 occurred when Capt. W. P. Moore of Sacramento, Calif., who wears the Distinguished Flying Cross and Air Medal, shot down a giant flying boat over the Mediterranean. Captain Moore was on an escort mission with bombers seeking out shipping in the Mediterranean when he fired upon a six-engine Blohm & Voss Bv-222 flying boat. [This is a new German long-range transport and reconnaissance type. According to British sources its six engines are 1,000 h.p. air-cooled BMW's. Wing span is approximately 150 feet, length about 120 feet. Maximum speed is said to be 200 m.p.h., cruising, 170. Its range is reported to be 4,400 miles. At first glance, the Bv-222 looks a good deal like the British Short *Sunderland*.—Ed.]

Captain Moore attacked the huge ship about 50 feet above the water. The plane caught fire and crashed almost immediately. Estimated passenger capacity of the flying boat was 200 troops, and it appeared to be heavily loaded.

Almost at the same instant that Captain Moore shot down the Italian transport, he was attacked by enemy fighters. They got in a burst that knocked out his left engine and also destroyed his hydraulic system. Moore warded off further attack and continued on one engine with the American bombers until returning to his base. Upon reaching the home field, Captain Moore had to employ the manual hand pump to lower his landing wheels. This is a job that requires approximately 400 strokes—and a stroke is comparable to the stroke used in rowing a boat. Moore couldn't hold up his arm when he finally got down.

Still another single-engine experience was reported by Capt. Charlie Earnhart of Lebanon, O., now missing in action. Captain Earnhart was on a strafing mission to Gabes, where he destroyed two enemy planes on the ground and strafed ground installations and guns.

His ship was struck by cannon fire from the field and a shell exploded in the cockpit, inflicting cuts and shrapnel wounds in Earnhart's left leg. At the same time his left motor was shot out of commission. Earnhart headed back to his base, manipulating the plane on one motor while administering his wounds. He even went so far as to apply a tourniquet, and any good first-aider knows this is no simple job under normal conditions, let alone while flying a P-38 on one engine. Captain Earnhart was later awarded the DFC, the Silver Star, Order of Purple Heart and the Air Medal.

As for criticism that the P-38 is a death trap because the pilot cannot bail out, I can only say this is so much nonsense. We found that in combat every pilot who had to hit the silk did so without any trouble whatsoever.

Bailing-out can be accomplished by the pilot either by rolling the plane over on its back and falling out or by pulling the ship up into a stall and jumping out between the booms and elevators just as the plane starts to spin.

Lieutenant Carlton, who now wears the DFC and Air Medal, discovered still another way of getting out—and certainly one of the most unique ways experienced by any of the boys during our stay in England and North Africa.

We were in England when Lieutenant Carlton was ordered up to intercept a Junkers Ju-86, high-altitude photographic ship. Carlton's plane iced up in a solid overcast and fell off into a steep dive. The indicated air speed was 600 m.p.h. Carlton decided to leave the ship at 25,000 feet. He tripped the canopy release, unfastened his safety belt—and the next thing he knew he was floating through space. Apparently a vacuum sucked him right out of the plane, and without injury to him other than a slight shaking up. Lieutenant Carlton explained later his only discomfort was in floating down through the overcast for 12 minutes, and trying to figure out his estimated time of arrival "somewhere over England."

In North Africa, another member of our squadron was escorting bombers on a mission over Sfax. His ship was hit by flak and caught fire in mid-air. The pilot, whose name I can't reveal, simply rolled the ship over on its back and bailed out from 1,500 feet.

I also had occasion to bail out one day. Six of us were strafing tanks when we were attacked from above by 16 German fighters. The first I knew about the attack was when the fellow flying on my left was shot down. Immediately I pulled the ship up into an Immelman, which brought the plane out above the fighters tailing me, and headed in the opposite direction.

It was useless for the enemy to follow because the radius of their turn in a loop or Immelman would have brought them out well below me. When I rolled the plane over and out of the Immelman, I found myself in the midst of another enemy flight. There was a Messerschmitt in my sights and I shot it down with one quick burst, but immediately I discovered three enemy planes on my tail.

I put the maneuvering flaps down in an effort to get away, only to have a cannon shell hit the flaps and make them jam in that position. When this happened, the best speed I could get was not sufficient to enable me to outdistance them and by this time I was separated from my flight.

Although I tried to maneuver out of range, I couldn't do so because of reduced speed. Finally they succeeded in hitting the left engine and it burst into flames. At this point I was only 50 feet above the ground. I pulled the plane up into a stall because I knew I had to get out. To crash land at this particular point over the terrain would have been fatal. As the ship stalled at about 500 feet, I

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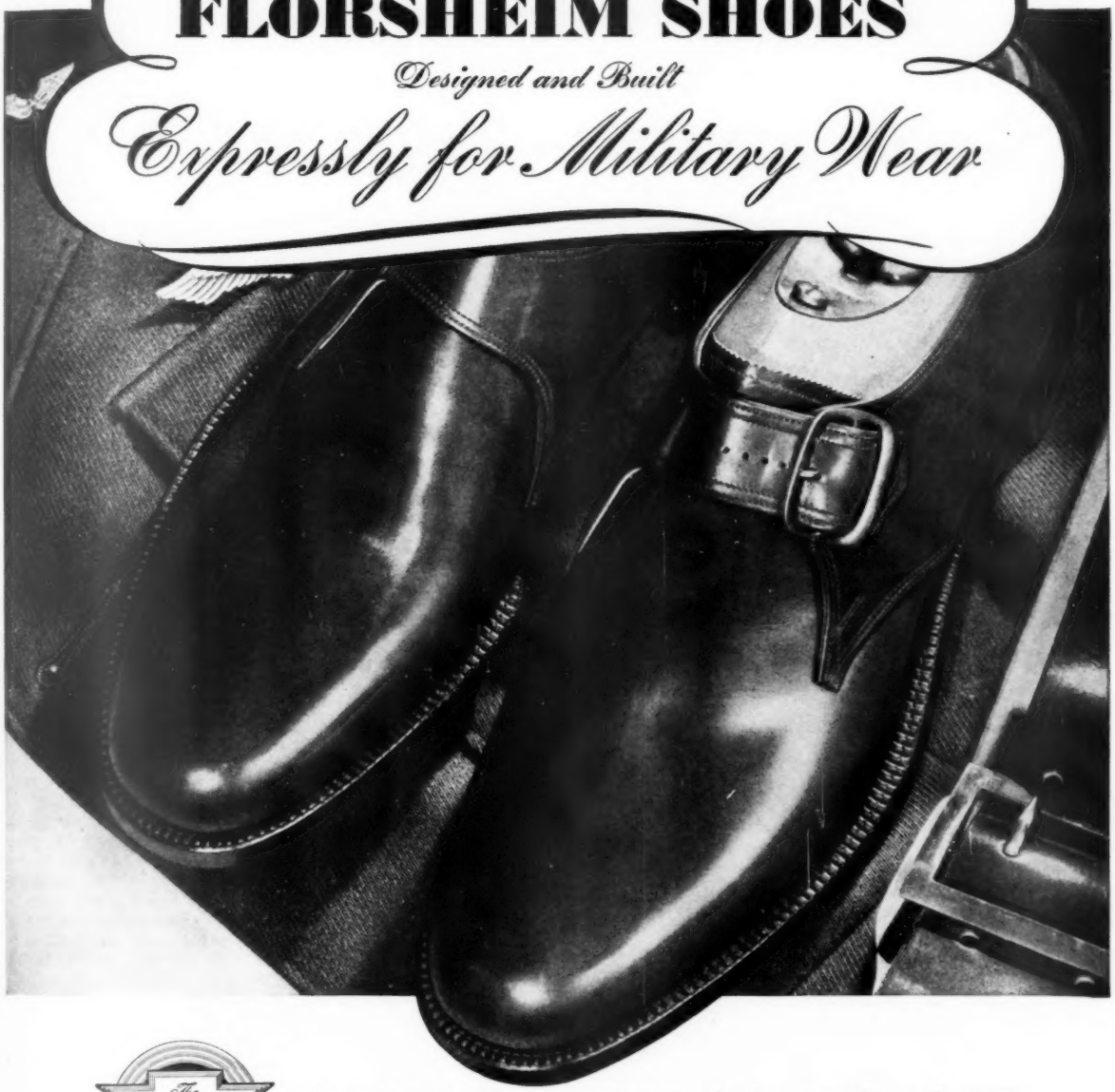

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jumped out through the booms and elevators just as the plane fell into a spin.

Fortunately, I landed behind our lines and, with the help of the Arabs and French, I managed to make my way back to base. Next time, however, I'll pull the rip cord of the chute a little sooner. Flying pieces of metal from the plane entered my body, but did no serious damage.

These examples of single-engine operation and bailing out in combat, regardless of the circumstances, should prove heartening to P-38 pilots on the verge of leaving this country for action against the enemy.

The P-38 was designed, as you may know, as an intercepter and high-altitude ship. But we soon discovered that if we were to get into combat in North Africa we had to fly at altitudes below 12,000 feet. There was far greater action at lower levels, and certainly there were more ships to attack. This put us on the offensive and was far more advantageous than entering combat by first warding off an enemy attack from above.

Our motto in the Air Forces is: "The sooner you start shooting, the better!" We always try to remember that the other fellow has much the same thought in mind, and since we are his idea of a target this motto is not one to be forgotten.

We were constantly looking for something to pick off, such as the German Junkers Ju-88 and Ju-87. These were more plentiful at lower levels and were seldom to be found above 15,000 feet. Therefore, despite the design of the P-38 for high-altitude fighting, we had to come down to lower levels to find a target.

Our low-level work included the strafing of trucks, tanks and columns, or anything else we could find. One day I wound up in a rather ticklish position, but once again the P-38 proved its worth and came through in grand style.

We were strafing trucks and tanks at low altitude, when our commanding officer of the Blank Fighter Squadron was shot down. A pill box got him, and as I looked back to identify the crashed plane the tail of my ship hit a telephone pole. The plane whipped over on its back, no more than 20 feet above the ground. I immediately kicked full top rudder and full left aileron, and this rolled me back into a right bank position. The ship trembled all over and sort of bounced crazily along through space. By holding full left aileron I retained this position and kept the plane flying at about 50 feet above the ground. I thought for a while I was a goner.

Finally I put the flaps down and this proved just what was needed to gain control of the plane, pick up altitude and return home. The flying speed had been greatly reduced by the accident and I had to hang on to the wheel for dear life, the plane vibrated so badly.

Other ships in the squadron saw I was in trouble, and I succeeded in telling them over the radio what had happened. As I headed for home, the rest of the squadron circled over me constantly and warded off any enemy attack. It was 360 miles back, or a two-hour trip at my reduced speed. When I finally landed, the pressure I had been forced to exert on the wheel had caused large blisters to break out on my hands. I was also dripping wet from sweat. But I owe plenty of thanks to that P-38 and members of the squadron who furnished me protection going home. I'd never have made it without them to help me. I don't mind saying I was scared to death when the plane hit that pole. Incidentally, the pole was knocked to smithereens.

Since returning to the United States, I am constantly being asked how the P-38 stacks up with the Focke-Wulf and Messerschmitts. My answer is that, due to the P-38's greater speed, we capitalized on that speed to come in and make a quick attack, then climbed to regain position for another attack. In doing this we achieved far better results than would have been possible in attempting to turn and dogfight with single-engined ships.

Nearly any single-engined ship can turn inside a twin-engined one if given the opportunity, consequently our tactics were based upon the fact that we had greater speed than the German planes. We always flew in units with teamwork between flights of four to afford us protection against attack and place us in position to go on the offensive.

The smallest flying unit was a two-unit element. We found it better for personal safety never to attack individually, but always fly with at least a unit of two ships. With this as a basic unit, we devised our tactics accordingly.

In most cases our flights (a flight comprises two two-ship elements) would fly almost abreast, each looking back across the tail of the other flights. This afforded complete protection from the rear in that we could see and turn towards any attack from that direction.

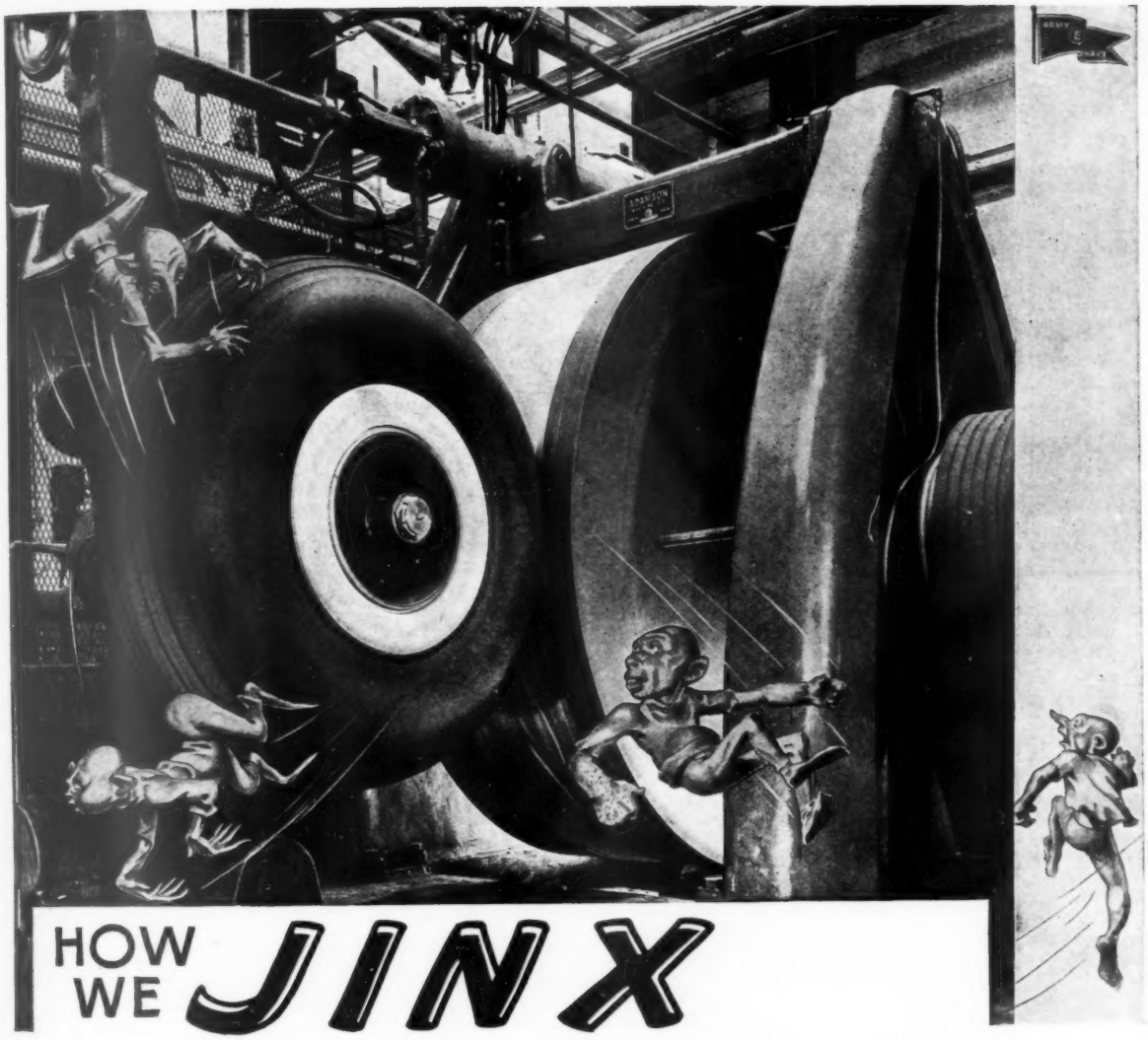
When attacking enemy planes, especially fighters, we enjoyed our greatest success in chasing them down to ground level. Using our overtaking speed to good advantage, we nearly always were able to either shoot down the enemy or leave him in very bad shape. One thing we had to adhere to when attacking in this fashion was to have some of our planes as top cover to protect us against rear attacks while concentrating on our own offensive.

This top cover was not always available, however, and at such times we had to remember "to look out the back way before going down the front way." The Germans often sent decoys down to draw some of us in pursuit, and then sent in others to take on the remaining planes in combat. Usually they planned this so that we were greatly outnumbered.

Whenever we started combat at a disadvantage, our first action was to ward off the enemy with a quick turn into the direction of the attack. Immediately after this maneuver we attempted to climb for altitude to deliver a return attack. If the situation was such that this was not possible, our flights would maneuver into abreast positions, which proved to be our best defensive order of flight. In this way we could continue safely until we were able to maneuver in such a way that the

FLYING

"Eat us, hell! He wants to know our normal rate of climb and the maximum manifold pressure of the engines!"



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advantage of the next combat would favor us.

Too much stress cannot be placed on having "the advantage of the moment" in combat. Every fighter pilot must be ready to ward off attacks when at a disadvantage and always take immediate offensive action when certain of his advantage. The uppermost thought in a pilot's mind should always be to complete his mission successfully, whether it be bomber escort, fighter sweep or reconnaissance. Upon completion of his job, he must concentrate entirely on getting back to his base. Stooging around, especially in enemy territory, without any definite purpose in view has always brought unhappy results.

The P-38 has proved its worth as an all-around fighter by performing effectively on long-range missions, either providing fighter protection for bombers or putting on a surprise attack on ground forces well behind enemy lines. The only disadvantage, if it can be called that, was the discomfort forced on the pilot by being strapped to his seat for five or six hours at a time.

Needless to say, at such times we keenly envied the bomber boys, who could always move around a little and even exercise if they so desired. All we could do on such trips was wiggle our hands and ears. But would we trade places with the bomber pilots? The answer to that is an emphatic: "Hell, no!"

All of which adds up to: "Once a fighter pilot, always a fighter pilot." And, frankly, that's the way I feel about it. I'll take fighter duty and the P-38 every time.

END

Guinea Pigs Grow Wings

(*Continued from page* 59)

for me. I'm a square peg trying to squirm into a round hole—a mud hole at that."

Ugh! Mud! My name, apparently. Me—the guy who had come to save the Air Force by helping to break the critical basic instructor bottleneck.

Too old to be a cadet, hungry for some aerial spot in the war, I'd tried first for the Ferry Command, egotistically imagining my 200 *Cub* hours was some stuff. It wasn't. I did manage to catch a CPT (now WTS) secondary instructor refresher, bounced speedily from it to a Chicago Army check ride in a big, growling 450 h.p. BT-13A.

I remembered vividly that check ride. I'd taken one look at the BT's dazzling instrument panel—at the three-pronged throttle quadrant with its unfamiliar mixture control and prop pitch knobs; at the gauges, flap handles and gadgets—and promptly started to claw my way back to the ground. Patient, understanding Capt. Richard Lively, traveling check pilot, gently pushed me back into the cockpit. Somehow I staggered through the check and an Army physical.

"Report in Enid, Okla., in five days," I'd been told. "We need you badly."

I had visions of comfy quarters, a quick and easy instructor refresher, a quicker commission and the life of Riley, teaching World War II's No. One heroes—flying cadets.

And here I was, deep in mud, plunked into a bare, unfriendly barracks, confronted by Lord knows what.

But I was also 900 miles from an Indiana home, wife and job. I had my name on a civil service contract. Besides, any job deserves a try and I didn't intend to spin out without taking a whack at it. Furthermore, I knew there were other civilian pilots like myself at the field. They'd also taken the tests in Chicago. I'd have company, at least.

FLYING

"The telephone company ain't gonna like this, bud!"

Footsteps clattered swiftly along the corridor and six feet of rushing man hurtled into the cold room. I also swooned with joy. It was Kenny Tiegs, young, lively machinist with whom I'd taken the CPT refresher at Curtiss-Wright in Milwaukee.

"Hi," Ken said, offering his hand. "Glad you finally arrived. We're going to be roommates. Good!" He plunked some books on the desk and started tearing off his snappy cadet uniform. Two minutes later, clad in athletic shorts and shoes, he rushed to the door.

"Can't stop now," he shouted. "Calisthenics. See you at mess."

The whirlwind departed and I looked to Private Mason for enlightenment. He grinned apologetically. "Things are run on a pretty fast schedule," he explained.

"So I see," I replied wryly.

Private Mason, a former cadet, was coach, instructor, educator, advisor and father-confessor for a dozen civilian pilots who had been propelled abruptly into the Enid school. He explained the schedule I'd have:

"Reveille is at 6:20; roll call 10 minutes later; breakfast is at 6:55; classes from 7:55 to 10:20; athletics from 11 to 12. Dinner is at 12:20. You'll fly from 1:30 to 6:20. Retreat is at 7, followed immediately by evening mess. From 8 to 10 you're confined to quarters unless you need barbering or wish to attend a post movie. Taps is at 10."

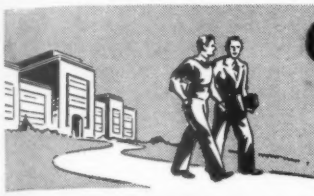
"When," I asked thoughtfully, "do you make your bed, clean up, shave, write letters, study?"

"In between."

We spent the rest of that muggy day buying uniforms—the regular cadet garb—insignia, shoe shine kits, blitz cloth (for shining brass), towels, toilet articles and whatnot.

Simultaneously Private Mason began my education. I learned how to make a bed, dust, shine and clean—prompting a mental note never to complain again about Mrs. S's housework. Private Mason showed me the bulletin board, daily and weekly schedules, "gig" sheets and community bathroom. He saw me assigned to a flight and section, taught me how to salute and, more important, whom. He dressed me properly by mid-afternoon and surveyed his handiwork with a critical eye.

"You look fine," he said—but I think



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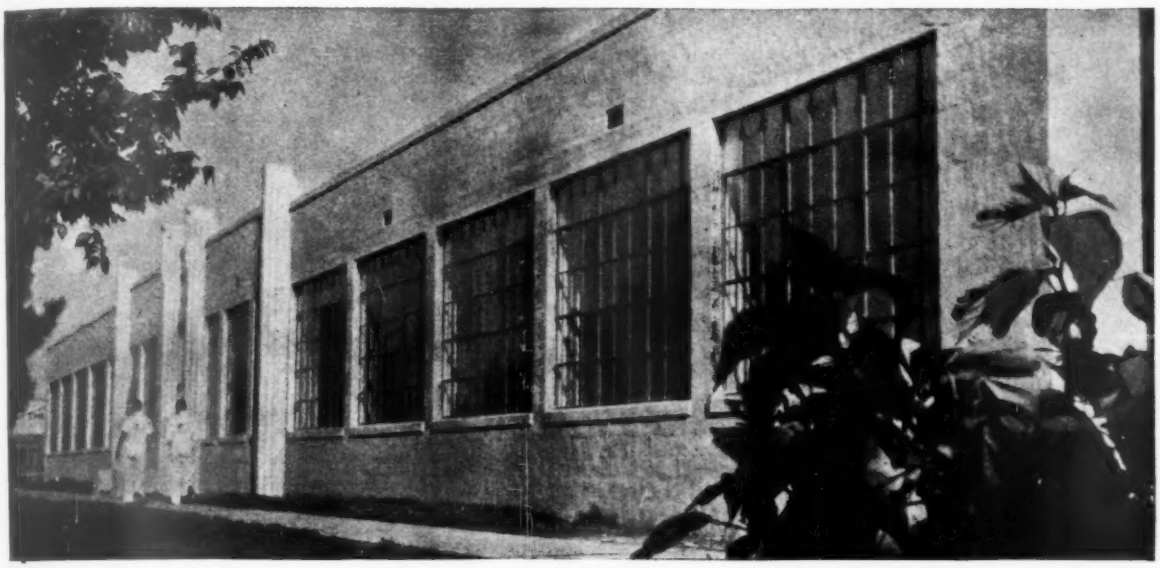

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- ☐ Women's Instrument Technician

his grin was forced. My shoulders and chest sagged from nine years of wrestling a newspaper typewriter. My middle contained an eight-pound roll of surplus. I'll bet I looked fine.

After evening mess I met the other civilian pilots: Carl Hickman, my other roommate, blond, square-jawed, kindly Minnesota amateur flyer who had left a good name band to fly for the Army; tall, dark, handsome, sardonic Walt Blandford, Louisville, Ky., youngest of us all (22) but the veteran in experience—2,300 hours in everything from *Cubs* to tri-motor Fords; Louis LeChien, young, wiry former CPT instructor at Pittsburg, Kan.; tall, husky Ed Snyder, Peoria, Ill., news photographer who flew as a hobby; Eldon Schueler, another CPT instructor from Austin, Minn.; Ralph A. Weaver, a Fort Wayne, Ind., salesman who had accumulated 200-odd flivver hours; John Miller, 41-year-old granddaddy of the bunch, a little, roly-poly, merry man whose effervescent good humor and gags pulled us from the doldrums many times; E. B. Murray, Chicago, former locomotive engineer, a shade younger than Miller; John H. Bos, 30, tow-headed, good-humored Battle Creek, Mich., flyer, and Doug Johnson, 25, slim, frail, lively, one of Blandford's former Louisville students.

Johnson examined me soberly—but there was a merry twinkle in his eyes.

"Welcome, guinea pig," he said.

"Guinea pig? I don't get it!" I replied.

"You will," he chuckles. "We're the first civilian class. No one knows quite what to do with us. But you'll get accustomed to it."

Johnson was right. The CP's (civilian pilots) took their confused status in stride with everything else. The first week was hard. Disorganized and uncertain, we fought the clock all day. Gradually we mastered the schedule and found more time for the greatest Army pastime—griping.

Sure we griped! It was healthy as well as fashionable. We griped every day—but on Tuesday we'd forgotten Monday's gripes, and on Wednesday, Tuesday's had faded away. That's why griping is an important pastime. It cleanses the spirit and boosts morale. At least, it did for us.

Since we would teach basic training, the Army had decided we'de take the full course first, including ground school and military formations. It would give us an insight into the whole lives of the cadets we would teach, not just their flying problems. And it would teach us the military fundamentals we'd need later as officers.

The schedule was swift, jam-packed and unyielding—exhausting physically, but refreshing mentally. The days tumbled over each other. No longer beset by the myriad little woes and worries of civilian life, with everything carefully scheduled and planned for us, we found it easy to fling ourselves into the job in hand, do it and reach hungrily for the next day.

Our civil service jobs paid us well—$300 a month. Regular hours, good healthy food, wise exercise and a driving schedule put a tingle in body and spirit. We slept like babes at night, absorbed the hot Oklahoma sun—it stopped raining after a week—and found ourselves in unfamiliarly excellent condition.

It was a satisfying feeling, enriched by the knowledge we were training for a valued and vital job.

Don't get me wrong. It wasn't entirely rhapsodies and rosebuds. The civilian program developed so quickly the Army was little better prepared for us than we were for the Army. There were fumbles—on both sides. But they were unimportant, never on the goal line. We survived. So did the Army.

We were part and parcel of Cadet Class 42-I, except that we had upper class privileges from the first, which meant five extra precious minutes to make all formations, and relief from the hazing—since stopped in cadet training—to which our classmates were subjected by the men of 42-H.

Happy-go-lucky Johnny Bos disliked upper classmen who hazed the cadets of 42-I and he was quick to discover that the hazers weren't quite sure how to handle the strange civilian pilots who looked and dressed and acted like cadets—but somehow weren't. Bos soon found a way to haze the hazers—much to the delight of his suffering classmates.

One day a cadet alongside Bos "popped off" in ranks. Instantly an upper classman whirled and growled: "Who said that?"

"I did, sir," said Bos naively—before the startled cadet could admit it. The upper classman glared at Bos balefully, then turned away.

Another time an upper classman, failing to note the CP in Bos's name tag, hazed him in ranks with:

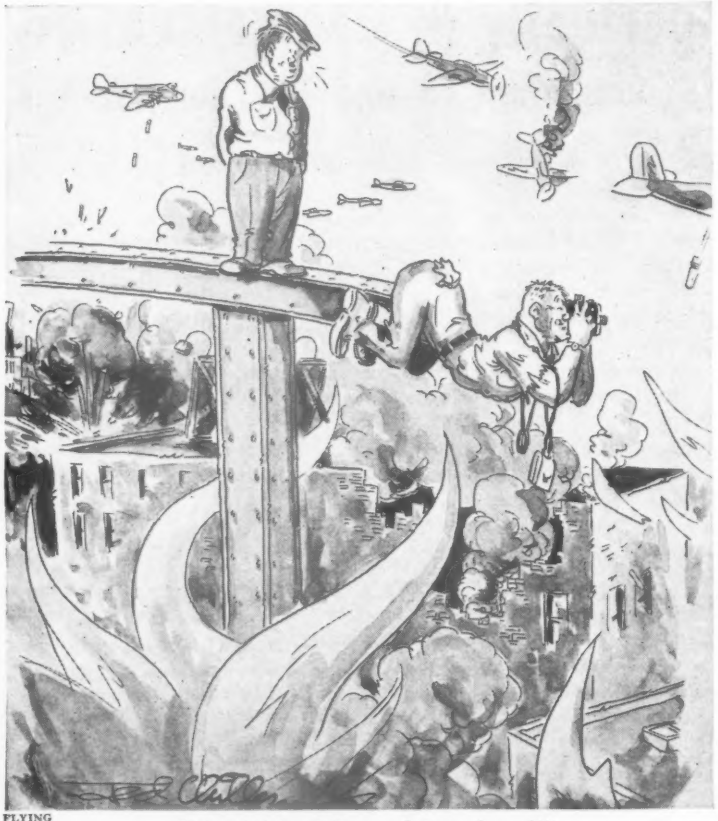
"When did you shine that brass, mister?"

"When did you shine yours, mister?" Bos replied sweetly. The hazer spotted Bos's name tag then and hurried away.

The cadets, hazed unmercifully, loved him. And to a man, the civilian pilots found the cadets marvelous. Perhaps you've heard of cadet honor. It's a treasured tradition among these embryo flying men. Every foot locker in Barracks 9 could be opened with the same key. Yet personal articles were as safe as a *Flying Fortress* over Germany. Well-mannered, poised, courteous, these fun-loving, sky-loving heroes made grand friends.

What little gloom and dissatisfaction we accumulated, we lost each day on the flying line. There, for five hours, we escaped the strict military formality and stiffness of barracks life. When not flying, we could lounge with luxurious laziness in the spacious stage house, cementing cadet friendships, bulling, hangar flying or, if we wished, studying, writing letters or practicing on the code machine.

(*Continued on page* 146)



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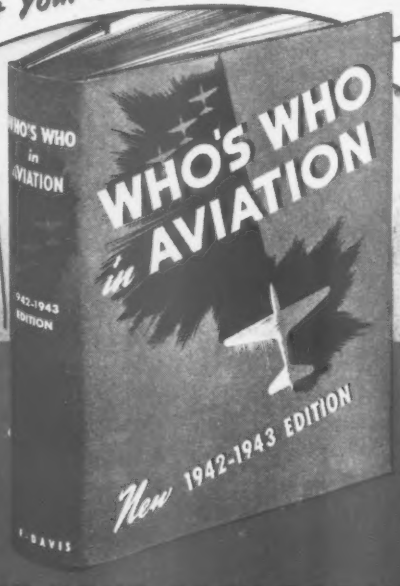

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Or we could sprawl in the sun beneath our tall, spidery control tower, watching the blue and yellow Vultees land with the regularity of dripping water, or pry their way into traffic for a takeoff. Traffic was unending, and at first I felt like a native of Shangri-La standing at Chicago's State and Madison at 5:30 p.m. I couldn't believe so many ships could get in and out of a field without locking wings. On rare occasions they did—but not once seriously. The field maintained an unbelievably low accident rate.

The flying line was, indeed, a zestful, refreshing daily tonic—especially as we grew to know and like the big Vultees, to thrill at the throaty snarl of their 450 h.p. motors. Instead of a huge, frightful beast, we found the ship a solid, stable plane with plenty of zip and go, a pleasure to fly once its temperamental quirks—touchy excess control stalls and sharp torque—had been mastered.

The days fled. We finished transition time and began the full instrument course given cadets in basic. Then came formation, cross-country, acrobatics, night work, cross-country and formation.

Johnny Miller and E. B. Murray, older than the rest of us, found the high-speed going rough, both on the flying line and in barracks. Both felt they were better fitted for other work. Their resignations were accepted. Carl Hickman had a part interest in a Minnesota airport that suddenly obtained a large CPT program. He was needed there and the Army released him readily, since he would still be teaching flying.

Influenza hit slender Doug Johnson hard and the flight surgeon suggested that he abandon the program and regain his strength. He did—subsequently enlisting as a Navy instructor. Bos' wife became critically ill, necessitating a major operation. Bos obtained leave—but returned six weeks later to complete his course.

All but five of the guinea pigs finished the basic course. We bade sad goodbyes to our cadet classmates of 42-I who went on to advanced training.

Having finished basic, the married men among us were allowed to live off the post. Single men were transferred to officers quarters. We zipped through three swift weeks of a 60-hour instructor-refresher that polished up our rough spots, bolstered our instrument time, gave us longer cross country training and time in the Vultee's blind back seat. Meanwhile we breezed through an officers' school and filled out many of the precommission forms.

Three months and 12 days after I arrived, I had my first students. Nervous as a mother hen, I clucked them through the first day, the next and the next.

"Just keep a jump ahead of your first students," Lieut. Walter Hamberg had told us in the instructor school. "You'll learn plenty from your first class. After that you'll be an old timer."

He had summed it up neatly, we found. I don't think one of the "guinea pig" civilian pilots, now second lieutenants in the Army Air Forces, would trade places with anyone—unless it be the boys flying overseas. Least of all, they have no desire to return to civilian flight instructing.

The work is exacting, but not too difficult. We average about four hours flying a day. We have at our disposal the world's best equipment for continuing our own training. The comradeship of Air Force officers is unmatched.

There's a lot, too, in that pair of silver wings over our left breast. We're proud of those wings—every bit as proud as a graduating cadet.

Being "guinea pigs" wasn't exactly a picnic, but we derived a rich satisfaction in knowing that from our class the Army and we learned a great deal.

END

RCAF Pilot Pool

(*Continued from page* 50)

constitute the authority through which squadrons are affiliated and adult officers appointed.

2. Administration of Air Cadet Squadrons will be handled through RCAF command headquarters.

3. Training objective will be the equivalent of the ITS course of the RCAF with a syllabus amended to meet this standard.

4. Grants: In addition to the existing government capitation grant of $1 a year per senior cadet there will be an annual maintenance grant of $1.25 per uniformed senior cadet and a band grant of $2 a year per instrument.

5. Equipment will be issued free to squadrons as soon as available. Issue will include: .22 cal. rifles, ammunition, targets, Morse signalling apparatus, unserviceable engines, airframes, aircraft recognition charts, stretchers and blankets for first aid, pieces of airframes, over-age engines and other items.

6. Publications already in use as manuals of instruction will be retained and new manuals will be issued by the RCAF in armament, aircraft recognition, map reading, navigation and mathematics.

7. Examinations will be provided by the RCAF through liaison officers.

8. Uniforms will be manufactured in quantity by the RCAF and issued to squadrons on a deferred payment basis of $2.50 per uniform cash with order and $3 at the end of each six-month period. Estimated cost complete, $14.50, tax extra, f.o.b. Ottawa.

9. Summer training courses at RCAF stations will be held for both officers and senior cadets. Officers will be able to become better qualified in the subjects they are teaching and cadets will make up for any lack of training during their year of instruction. During their stay officers and cadets will be guests of the RCAF. Officers' training will be previous to that of cadets'.

10. Communications in all matters of administration and training will be directly with RCAF command headquarters. On League matters squadrons will still communicate with League headquarters in Ottawa.

Pilots of World War I, such as H. P. Illsley and R. B. Hall (above) lead cadets.

Under this plan the major task seems to have been transferred to the RCAF, but air force officials insisted that it should not be so.

"You civilians on the national board, in provincial committees and in local committees of the Air Cadet League have still a tremendous job to do," Group Capt. H. P. Crabb, director of manning, RCAF, told the League.

"If people in the League do not continue to form new units, they are falling down in their duties," he declared. "The major function of the League is to create public interest and maintain enthusiasm for Air Cadet work. In performing that task it is doing a job that is equally as important as training and one that it can carry through better than the RCAF."

Air Cadets have gone to summer camp at flying stations of the RCAF. There the boys gained a new conception of Canada's war effort in the air. They helped move aircraft about the airport, stood guard duty and took part in parades. They learned the essentials of control tower operation, parachute packing and made careful inspections of the cockpits of training planes. They did not fly but they learned much of what a young airman of the RCAF must know and they filled out well the practical side of their training which will be mainly theoretical for the rest of the year. Their civilian volunteer instructors and officers went to other training camps where they took teacher training courses.

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those of the RCAF except for a change in collar design and the addition of a distinctive Air Cadet crest.

The reason for Air Cadet training being identical to air force instruction was stated by Group Captain Crabb. "Most urgent need of the air force is a reserve of boys suitable for training as pilots and observers," he said. "We will in the future need more men with physical and educational qualifications for these positions than will normally be available. The training of Air Cadets will be a means of filling the need.

"Under wartime policy it is a great mistake to train boys in aviation who will not be able to take their place in the air force," he said. "It makes for costly procedure on the part of the air force and disappointment of both boys and civilian supporters."

Total instruction time for this basic air cadet course is 288 hours. Cadets are expected to complete the syllabus in two years. "This may be done with a time table of four hours per week for 36 training weeks each year," the official syllabus points out. "Under the two year training plan, cadets commencing the course at age 16 will be enabled to complete it. Those enrolling at age 15, will, in their last cadet year, be able to render valuable assistance in the training of cadet recruits, and may participate in advanced specialized training the squadrons may develop."

The first course is administration and organization. It requires 14 hours. Included in its scope are the history of air cadet work and the purpose of the movement, a study of discipline and its importance in RCAF life, outline of the purposes of standing orders, routine orders and other communication devices, study of ranks and badges of all forces, and of flags and the interpretation of the organization of the RAF and the RCAF.

Aircraft recognition takes 20 hours. Boys are required to know a minimum of 40 aircraft including the major British, U. S. and enemy types. They are taught recognition points and definitions of airframe terms and national aircraft markings.

Airmanship, a 12 hour course, includes principles of flight, areo engines and Link Trainer work. Cadets are given definitions and practical application of air speed and ground speed, action of the wings in flight, stalling, gliding, aircraft control and so on. They learn of the four-stroke principle of aero engine operation and study carburation, ignition, lubrication and cooling. Link trainer lectures give them an understanding of the machine and occasionally they are given "flights."

Anti-gas training is important. This takes eight hours. Boys learn to don respirators in a few seconds, are told how to recognize war gases and how to protect themselves against them with anti-gas clothing. When possible they are sent through a chamber of tear gas and forced to take off their respirators inside the chamber to give them an unforgettable conviction of the importance of keeping a respirator on when gas is present.

Armament training is a prime love with most air cadets. In their 10 hour course they fire .22 caliber rifles in target practice on indoor ranges. Common faults when aiming, adjustment of sights, trigger pressing and faults of firing are all discussed. They are taught how to look after a rifle by cleaning it carefully and coating with grease when putting it away for long periods. They also have a general description of the .38 caliber revolver and are taught its uses and advantages, correct grip, stance and posture, sighting and trigger pressing, safety features, and care and cleaning. They are given revolver aiming practice but do not use cartridges. They are introduced to the Browning machine gun and taught the names of its parts, operation of its mechanism, fitting and assembling procedure, breeching up, changing of feed direction, loading, unloading and general maintenance.

Drill is a paramount phase, 30 hours all told, and a feature of almost every air cadet parade. Air cadets follow the RCAF outline which has them perform all movements with a basic formation of a squad in three ranks. "Foundation of successful training is discipline," they are taught. "Discipline requires the immediate obedience of the individual to the commands of his leader. The higher the standard of discipline in a body of men, the simpler it is to control and direct them efficiently."

(*Continued on page* 150)

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(*Continued from page* 148)

Air cadets are required to pass examinations for a senior first aid certificate. Health is all important to airmen and air cadets are therefore taught how to look after themselves and prevent disease. Their hygiene and sanitation course takes four hours. The physiology of flight section is of greatest interest. It presents information on the use of oxygen at great heights, the occurrence of altitude sickness and care of the ears.

Mathematics have proved the downfall of many an RCAF recruit. Air cadets take 28 hours instruction to make them sufficiently well qualified to suit the air force. They study arithmetic, algebra, geometry and trigonometry.

The study of meteorology is carried on in leisure hours as well as on duty. Cadets are taught to study clouds and weather every day. Headings of this eight hour course include: importance of meteorology in aviation, weather maps, atmosphere, wind, moisture in the atmosphere, clouds, precipitation, visibility, ice formation and weather observation.

The biggest course of all is in air navigation. More and more the RCAF has stressed navigation as training approached its optimum cruising speed and air cadet instructors have followed suit. A total of 58 hours is given to dead reckoning navigation, map reading and compasses. Under navigation the boys learn the history of navigation, history of instruments and present instruments in use, methods of navigation, latitude and longitude, triangle of velocities, air plotting, methods of finding wind velocity and position lines.

Physical training with an allotment of 30 hours is tied in closely with drill.

Air cadets are required to attain a minimum standard of sending and receiving aural Morse code at eight and six words per minute respectively and sending and receiving by lamp at four words per minute.

Air Minister C. G. Power recently gave added significance to the Cadet plan by declaring: "Already more than 100 young graduates of the Air Cadet training plan are making history with the RCAF here and abroad. That, of course, is one of the primary ideas behind the Air Cadet movement—to provide a short cut to actual flying training, paralleling as it does the initial training given regular air force trainees.

"I would like you to realize that the Air Cadet League is of tremendous importance to our winning the war. This is a young man's war. This is an airman's war. We have to have young men and we have to have them trained . . . just as quickly as possible. We look to the Air Cadet League as our reservoir. It is living, vital . . . not a showpiece. What is more, it is providing thousands of boys with knowledge and training that will make them invaluable in the days when the world's skies will be filled with wings of peace."

END

Will It Run?

(*Continued from page* 23)

probably warrant another word or two of explanation.

Ford could have started delivering *Liberator* bombers less than a year after receiving the order, if he had turned the drawings over to his job shop and had them custom-built by hand. Or he could have started deliveries in 14 to 16 months with a limited amount of tooling.

But the understanding was that the Army wanted a great quantity of heavy bombers in 1943, and Willow Run is part of the answer. It is entirely possible that this one plant will deliver more than 3,000 heavy bombers to the Army Air Forces this year. Ford gambled on a lengthy, elaborate tooling program for a possibly short, high-speed production run.

Willow Run can take minor design changes in stride. But any major renovation of the airplane may throw a monkey wrench into the Ford machinery.

As to point No. 4, many individuals and agencies are to blame. Willow Run currently has about 35,000 employes. It will have more than 60,000 at peak production. Hiring and training that number of workers is a stupendous task in itself.

Willow Run is located more than 20 miles from Detroit, in open country. There is a terrific demand for housing in the immediate area, but dormitories for only a few thousand persons have been erected. Many who obtained jobs there so blithely last summer, when the weather was mild and gas rationing was something that existed only along the Atlantic coast, have found it more convenient to quit and take jobs nearer home. Thousands of youths who sought the glamor of work in a bomber plant have been inducted into the armed services.

Sorensen reported last December that in the preceding month 3,000 men and women were hired—while 2,700 quit or went into the Army. While materials is the prime headache among other components of the aircraft industry, at Willow Run it is manpower.

Womanpower will help solve the problem. There are more than 10,000 women workers at Willow Run now, and the percentage is rising rapidly. Better transportation facilities are needed, too, if new workers are to be attracted there. The training school operated at the plant had 3,800 employes enrolled at last report.

The foregoing conclusions are those of this reporter, based on the information available to newspapermen in Detroit who have attempted to cover the development of this huge bomber plant. Subsequently, both the Office of War Information and the Truman Committee have investigated Willow Run. Such findings as have been made public coincide with these conclusions and fill in some details which had been lacking.

Nose section of B-24, suspended from elevated rail, is lowered into place.

The OWI report revealed that while the first completed bomber was three months behind schedule, the plant on February 14 had caught up with the schedule laid down late in 1942 by the Army Air Forces, and promised to achieve peak production by the end of the year.

Since then, however, the Army has again changed its plans with the result that Willow Run now is scheduled to complete a preponderance of its total output. The emphasis has shifted from knocked-down-assembled-elsewhere to finished bombers at Willow Run. This, of course, means an upward revision in original manpower estimates.

The Truman Committee, which came to Detroit with blood in its eye, felt better after touring the plant and talking with Ford officials, and left with the pronouncement that Willow Run "compares favorably with any other airplane plant in the country as far as actual production work is concerned—and we have seen them all."

This simply meant that the senators found production better than Washington rumor had painted it. They found that the pictures released by Ford showing full assembly lines were not so-called "phonies."

But—and it is a mighty big but—they found the manpower situation at Willow Run in a deplorable state. They found Ford ready and willing to hire 400 new workers a day for the next six months, but actually getting only a fraction of this number. They found housing and transportation facilities hopelessly inadequate. They found a 56 per cent labor turnover in eight months, and a high

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rate of absenteeism.

For example: during the first 16 days of February, 750 employes quit their jobs at the bomber plant, 403 of them to enter military service. Sixty-six of the remainder said they found the distance too great; 65 quit to take other jobs; 29 refused to take the jobs to which they were assigned; two were unable to find transportation; 11 were unable to find living quarters; 72 were in poor health; 36 were needed at home; and 13 went back to their farms.

Back of the high rate of military inductions among Willow Run workers was a Ford tendency to hire young men of draft age, despite the warnings of such men as Col. George E. Strong, internal security officer of the Army Air Forces Central Procurement District, who more than a year ago urged greater emphasis on women.

Back of the other problems—transportation and housing—is a natural Ford tendency to avoid high taxes. It would be unfair to place all the blame there—dilatory tactics and red tape on the part of Federal, state and local authorities have been greatly responsible—but Ford must shoulder some of the responsibility.

Willow Run is out in the country, more than 20 miles from Detroit, four miles from Ypsilanti, which had a population of 12,000 in 1940. Ford already owned most of the acreage on which the plant and airport now are situated. And the plant was very carefully established just across the line from Wayne County, of which Detroit is the county seat. While it is true that Willow Run is a Defense Plant Corporation project, and therefore not overly concerned with tax rates at the moment, Henry Ford has stated that he intends to acquire the plant after the war and continue aircraft production there.

It is significant, too, that Ford blocked all attempts of the Federal government to establish a permanent "bomber city" housing development at Willow Run. The reason, according to his critics, being to avoid creation of an incorporated community with power to tax.

Whatever the intent, the result is that bomber plant workers, for the most part, must travel great distances. Most of them live in the Detroit area, where there are plenty of jobs paying just as much, infinitely nearer home.

The severe weather of the past winter has had a marked effect on "quits", retarded hiring and on absenteeism. But there again, the matter of distance is the exaggerating medium.

Morale in the plant isn't the best by any means. Executives of Local 50, UAW-CIO, which has a union shop contract with Ford covering the bomber plant, have compiled a lengthy list of grievances which, they charge, the company will not negotiate with them. And the union still is trying to get Ford to establish a joint labor-management war production drive committee of the type which has worked wonders with production in other Detroit plants, notably Packard.

There are other grievances listed by the union, but the combination of green supervisory personnel, green union leadership and high labor turnover can account for a lot of this. The union likewise finds it difficult to discipline a membership with which it has had only the most casual relations.

What the Truman Committee, or any other agency, can do about these manpower problems no one professes to know. At the present rate of progress, the war will be over by the time they are solved.

Meanwhile, Ford engineers have pretty well licked their tooling and preliminary productions problems. This is all the more remarkable when it is pointed out that there isn't an experienced aircraft production man in the place. Some 250 key personnel were indoctrinated at Consolidated's San Diego plant and then brought back to create Willow Run.

There is almost a complete absence of titles in the Ford organization. But the two men now primarily responsible for turning out bombers are Logan Miller and M. L. Bricker, both veteran Ford automotive production men.

They designed the plant and its tooling without any preconceived ideas or inhibitions regarding airplane manufacture. If the tooling is complex, it is so the manual operations will be simple and foolproof. If it is comparatively inflexible, it is because high production rate is the keynote.

Ford people rationalize it this way:

There are two ways to lose a war:—have too many inferior airplanes or too few superior airplanes. In Willow Run they see a happy medium and a stabilizing influence on the grand strategy of aircraft procurement.

For while some aircraft plants may be producing a comparatively limited number of the latest types of warplanes, they expect Willow Run to be pouring forth vast quantities of the next-to-the-latest type—thus formulating the backbone of the bombardment offensive and the heavy cargo services.

END

15 YEARS AGO

FROM the May, 1928 issue of this magazine:

"Is 400 m.p.h. in sight?" asked Lieut. Comm. Frank W. Wead in an article on racing planes. He added, 350 m.p.h is a "cinch right now, what with a British seaplane attaining 305 m.p.h. in an Italian race" . . . Germany loaned the U. S. a turn and bank indicator in exchange for information on the newly developed Ockner-Myers chair. Germany wanted the chair information for the use of their "airplane pilots." . . . The University of Michigan had just installed a wind tunnel for use in aerodynamical research and the development of new types of planes.

The Curtiss *Fledgling,* designed as a new primary and advanced training plane for the Navy, was successfully flight tested. . . . Pilot Roscoe Turner owned a transport that had been used as a radio studio, piano mover, flying cigar store and clothing shop.

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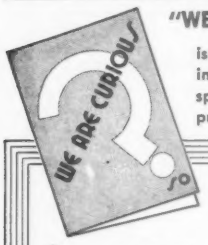

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Those Young Old Men

(Continued from page 27)

it, have been doing a tremendous transportation job involving ocean flying.

Because of his importance, they gave him a desk. He found that the desk wouldn't fly. He's seldom at it. If you have business with him, the best system is to catch him walking from the flight and service offices to a *Liberator* or an experimental job.

He got his start with the Rogers Aeronautical Company at Miami, Fla. His older brother headed it. The company had an airline stringing out into the British West Indies and built seaplanes. Curtiss came along, bought up the company. Russ went along as one of the assets. He tested prototypes for Curtiss until 1932, when he joined Richard Archbold, the explorer.

Russ saw New Guinea, practically all the Pacific fronts where America's forces are fighting, flying and advancing. There were few places in the world he didn't visit.

He joined Consolidated in September, 1940. You'll find better than 6,000 hours in his log book. A lot of his time isn't written down.

An attractive secretary usually tells you:

"Mr. Rogers is flying."

If he is, you can bet his executive assistant is up with him. He's Richard A. McMakin, and the chances are if you've flown a bit on the airlines he has handled the plane on one of your trips. Dick is just barely in the "young old" classification. But he learned to fly in St. Louis 14 years ago, and he has more than 10,000 hours, most of it on domestic and European airlines. He's a practical engineer, as is Rogers, and he knows his navigation after all these years.

Rogers' one anathema is the phrase "chief test pilot." He says there isn't such a man at Consolidated. He and McMakin fly the experimental prototypes, turn them over to other pilots later. Then they get a concensus.

"Many heads are better than one in deciding what needs to be done to make an airplane better," Rogers says.

Rogers has succeeded in getting men who have had substantial experience in big airplanes to test the *Liberators, Catalinas* and *Coronados*. One of his key men is blond Jim Barwick, born in Bainbridge, Ga., June 26, 1900. Jim, an "old young man" with a little matter of 12,000 hours of flying to his credit, has had experience barnstorming in the old Hisso-Standards and JN4's, has owned, managed and flown airlines, has sold airplanes and is credited with running prototype tests on the *Hudson*.

He's one of the few lads still flying who got overseas during the first World War —three months as a ferry pilot with the Northern Bombing Group. Jim soloed as a Marine pilot at Pensacola, heard that people in the northern states were willing to pay $25 for a ride in an airplane, and quit Georgia forever. He won a reputation in the mid-west when he settled down in Sioux City, Ia., founding Tri-State Airlines. He soon sold half-interest to Art Hanford, a wealthy local flyer, and began operating between Omaha, Sioux City, Sioux Falls, St. Paul and Minneapolis, extended to Kansas City and Tulsa.

Jim was a flying manager for four years, sold out to Hanford in 1933. In 1935, Hanford sold out to Midcontinent.

From 1933 until 1936, Jim flew with Northwest Airlines, and in 1936 went with Lockheed, where he did prototype and production testing.

In 1941, he joined Consolidated.

You can't overlook lanky, good looking, curly haired Richard Mitchell, either. You've seen his name as captain pilot in plenty of transports.

Dick was born in Woodstock, Ill., February 19, 1910. Since soloing when he was 17, at Culver City, Calif., he's built up a reputation as an ocean flyer and has put 7,000 hours in his log book. Now he's a flight supervisor at Consolidated, but, like Rogers and McMakin, he doesn't go in for flying a desk.

Like the others, he came up the hard way—he got flying time in exchange for pushing airplanes around.

His first hitch was with Pacific Marine Airways, flying to Catalina. Then he went with Air Ferries, Ltd., flying across San Francisco Bay. After that he flew for three years for William Randolph Hearst. After that, five years with United Air Lines, and considerable time with American Export Airlines.

He's famous for over-water flying, because, next to the air, he likes the ocean best. He's a crack navigator—picked it up himself, practicing celestial navigation when he was with the airlines—and his hobby is sailing.

Douglas T. Kelley is known throughout the southwestern states as "Doug." Born at Fresno, Calif., December 23, 1901, he rates as one of the "young old men." He can show you more than 5,000 hours of flying since he was graduated from Kelly Field in 1925. Part of his time was spent as an instructor with Ryan Airlines. Later he was test pilot for the C. S. Mahoney Aircraft Corporation. Finally, he branched out for himself, and became president, general manager and chief pilot for Air Tech Flying Service, which operated at San Diego until the war began.

"I sort of got the idea," says Kelley, "that maybe I could do a wartime job for Consair, so I signed up."

When you talk about Art Bussy, with 7,500 hours up, you have to go back to the days of the Gates Flying Circus. Bussy worked for Ivan Gates in 1929, when he ran the Gates Flying Service at Holmes Airport, on Long Island.

Bussy was born April 19, 1903, and soloed at Schenectady, N. Y., in 1923. After leaving Gates he operated his own flying service for a time, became sales manager for an engine manufacturer and at various times was test pilot for Beech, Bellanca and Edo.

Jack Elliot came down out of Alaska to do his bit. He'd been up there for about seven years, working with Star Airlines, at Anchorage. He was famous in all territory north of the United States border

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as the man who never got lost.

Elliot was born in October, 1903, at Alameda, Calif., and has collected more than 7,000 hours since he soloed at Oakland, Calif., in the fall of 1927. He immediately formed a partnership with William Duck, began operating there, and soon was known up and down the coast.

He met a lot of lads who had been flying in Alaska, and decided to take a whack at the north country himself in 1934. He knows Alaska better than nine-tenths of the people who live there—and flew out over the Aleutians a long time before the Japs decided to settle at Kiska and Attu.

Jack's favorite mount up there was a Bellanca *Skyrocket.*

He talks calmly about having his motor swallow a valve over Kodiak, setting down on a lake and radioing for another plane to pick him up; of shedding his tail surfaces 300 feet above Illiamna Lake and going in nose first; of searching for nine days and finding a couple of pilots who were forced down by ice; and a thousand other experiences.

"But when war came along," he says, "I couldn't stand being that far out of it. I came down here to San Diego and began testing."

Another man with a past is Rodney H. Jackson, native of New York City. He qualifies by being born August 23, 1905. He soloed at the United States Naval Reserve base at Squantum, Mass., in 1925, later became pilot for W. K. Vanderbilt. After that, he was operator and airport manager, as well as pilot, for an airline established between New York City and Southampton, Long Island.

You'll find plenty of men old in experience and young in years in the pilot's room at Consolidated in addition to these. For instance, there's George C. Pomeroy, who has more than 21,000 hours. He soloed at Toul, France, in 1917, served in the United States Army, flew the air mail during the early days, and then built a national reputation when he flew for Cities Service Corporation. He is exceeded in number of hours only by E. Hamilton Lee, famed airlines pilot.

Frank C. Courtney not only flew for Great Britain in the first World War, but later became a test pilot, designed his own airplanes, and became a well known aviation writer. Courtney is in his forties, knows his seaplanes right down to the last blind rivet.

Ralph Devore, with 11,500 hours, is another veteran of World War I. He was born November 30, 1892, at Indianapolis, Ind., soloed with the United States Army at Arcadia, Fla., in 1918. Among the companies he has worked for at various times are the Ford Motor Company and American Airlines. He was also with the CAA.

James R. Lund gets into the veteran's class with a birth date of May 16, 1901, at Council Bluffs, Ia. Lund has managed and owned half a dozen flying services at various times. Until recently, he was chief pilot at the Rankin Aeronautical Academy at Tulare, Calif.

Then there's Theodore Roosevelt Howe, born January 10, 1901, at Rantoul, Ill. He watched Army planes around Rantoul, decided he had to learn to fly, became an Army Air Corps cadet, and was graduated from March Field in 1922. He's held a reserve commission ever since, has 13,500 hours with such concerns as the Ford Motor Company, for whom he was test pilot and airline pilot, and American Airlines. Sandwich into this considerable barnstorming at the early part of his career, and a year with the original T. A. T. "train and plane" service transcontinentally, and you have another real veteran.

Add to the roster William T. Swain, born March 14, 1898, who soloed at Crissy Field in 1922; and E. Walter "Walt" Gray, born March 23, 1905, at Baltimore, and you just about round out the picture. Gray graduated from Randolph Field in 1932, has chalked up 6,500 hours, most of it in the employ of Pan American-Grace. He came back home to join the war effort.

The flying they do is exacting and hard work. And the hours are long. There is scarcely a man in the huge organization who doesn't fly all he is allowed. They're taking the big *Liberators* more than five miles up every working day in the year. They're flying thousands of miles across the seas. They're flying more thousands of miles from coast to coast.

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They're up in the air, and they love it.

END

World Partnership in the Air

(*Continued from page* 55)

roar along the lanes toward what obviously will be highly destructive conduct. They also note the split-tail Lockheed *Lightnings,* the Bell *Airacobras,* the Curtiss *Warhawks,* and other types of bombers, fighters, intercepters, reconnaissance, cargo and passenger planes as they hurry along toward the fronts in a steady stream. And the word that all that power has not come for exploitation but instead is come to enforce the policy of live and let live, is working a new spirit into the peoples of this earth. Our airmen are preparing the way for permanent peace on this earth. This is the new diplomacy.

Many bases for our aviation forces have been developed outside of our continental limits. Steps should be taken at once to make all bases which figure in our hemispheric influence, permanent acquisitions.

It is not fitting that any European nation should own powerful or potential air bases off our shores. While in the control of friendly nations they are not a threat. But geopolitically they are a part of the Americas and I favor immediate negotiations to acquire all of these islands as parts of existing nations of the Western Hemisphere. A commission would determine the method of adoption and which American nation they should join. Of course some of these island groups are now—and others might become—successful independent republics, and these would be safe under a revitalized Monroe Doctrine.

At present we own very few of the several hundred bases which we have developed and paid for dearly along the routes being used by the Army Transport Command. We have no right to establish beam and weather controls on some of these routes. We have no right to use many of them commercially. This is true of the several western Atlantic bases acquired from Great Britain in the famous destroyer deal. That, in my opinion, was an instance in which our negotiators might well have added a few western horse traders to their delegation.

The other great air bases which we have developed, or shall have developed in Europe, Africa, Asia or on islands will have to be dealt with in the treaties which will follow the war. These air fields should be available to all nations for legitimate commercial purposes. We will approach the peace conferences with an attitude of fairness to all concerned, but with the determination to end the threat of war.

The immediate post-war air trade route competition will be principally between the United States and Great Britain. Fear is being expressed in England over the development of long cargo routes by our Army Transport Command, as well as our improved cargo planes and plane production. Britain has so long ruled World surface commerce that the prospect of a large share of the new elite trade slipping away is not contemplated with equanimity.

I see no reason for us to enter into any cutthroat competition with Great Britain or any other nation along these air trade routes. We will have no difficulty in working out fair and mutually advantageous arrangements with Great Britain. Many years of dealing between our peoples have developed a *modus operandi* for such negotiations. The Anglo Saxon has a fundamental sense of fair play, because of his basic training in the tradition of sportsmanship. With these people (and with other European countries) we can deal on a reciprocal basis. But the Pacific ocean is another problem.

The United States is developing great bases all over the Pacific. When Japan has been cured of her Superman complex, and has been forced to relinquish all of the countries and islands she has grabbed and despoiled, those bases will still be there. We may not want them, but we cannot afford that any other nation take them over. We will be stuck with them, and we, or some international force to which we will be the chief contributor, will have to keep them up, or

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writes Pvt. G. P., Gunnery Base, Gila Bend, Ariz.

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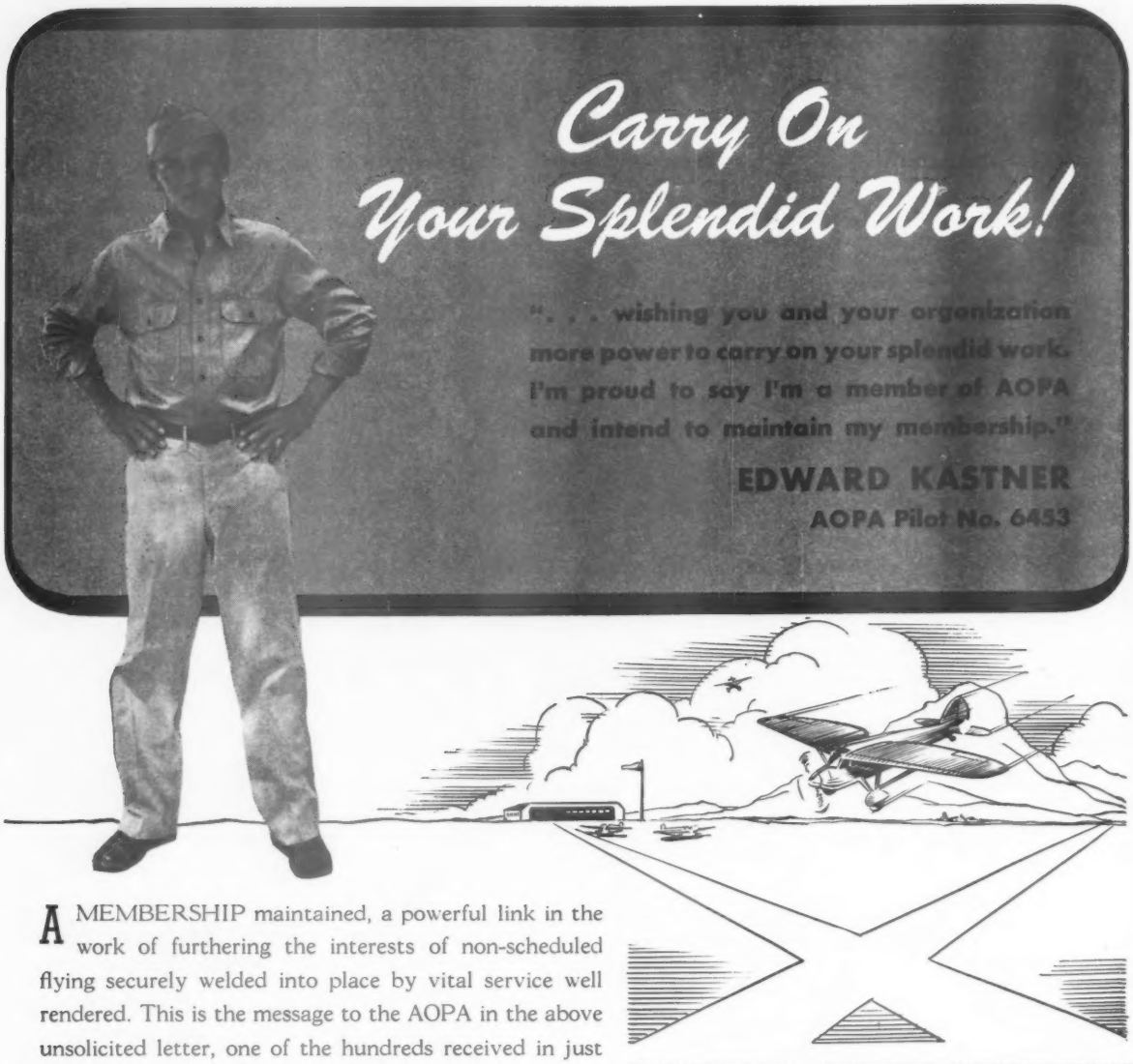
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Future in Aviation

(*Continued from page* 34)

such selected schools for their literature to get the details of their course of study and training facilities.

Some of the schools today are devoting their entire efforts to training military and airline personnel and do not have commercial courses available, but they are expected to resume normal operations after the war is won.

Pay particular attention to whether the school or the courses are Government-approved, or whether they are under contract to the Army Air Forces or other branches of the Government. Such facts may not be given in the advertisements but they generally will be found in the printed material. If a school is approved or under Government contract, you can be sure that it will be satisfactory if it has the type of course you are looking for. An approved school has met certain Government requirements as to the course of study, shops, equipment, classrooms, instructors, etc. Do not let the price of a course be the deciding factor in your selection; prices are deceiving.

In selecting a school get the answers to such questions as: What is the reputation of the school in the industry? What do the graduates think of it? Do they think it was worth the cost and time? Did they get jobs when they graduated? How long has the school been operating?

Now for a few pointers on getting a job when you have completed your training. Apply in person if you can. The employer will take more interest in your application if he finds that you are a graduate of a good aviation school; that you have had special training. Remember you have to sell yourself: show the employer what you can do for him; he is not interested in what the company can do for you. Tell the employer what kind of a job you want: don't tell him you can handle anything he has to offer, he knows you can't. Present a good appearance: be properly dressed if applying in person; or if writing, present a neat, well written letter. Tell all you can about your training and experience. *If you have what the employer wants, he will want you.*

END

Report from Washington

(*Continued from page* 64)

dinances are not a solution to it. All authoritative officials in every community wherein lies an airport should seek to use the experience and knowledge of the CAA to eliminate the hazards that already exist and to prevent the development of other hazards in areas surrounding our airports.

The necessity for uniformity in zoning regulations cannot be overstressed. Some of the larger airlines operate in many states. At least one operates in 20 or more different states. If each state or each municipality were to follow solely its own inclinations in the adoption of the necessary ordinances (and particularly without full knowledge of the minimum requirements in such matters) the resulting confusion might possibly lead to an increase in hazards, rather than their elimination.

No one urges that owners of private property be put to heavy expense to eliminate hazards to civilian and military aviation. Under the terms of H. R. 1012 authority is given to make proper restitution to private individuals or corporations. Speedy action should be taken by Congress looking toward the establishment of this authority that the welter of detailed work involved in carrying such a program into effect might be accomplished with the least possible delay.

Congress has shown wisdom and foresight in its attention to aviation legislation. Many of the problems and difficulties which were blindly faced in meeting the issues of rail, steamboat and automobile transportation in the past, are being eliminated by the experiences gained in their solution. Aviation is such an all important rapidly growing and expanding industry, that obstacles to its extension should be eliminated in advance, at every possible opportunity. Today, one of these major problems is this question of airport zoning. The concerted co-operative consideration of it on the part of local and national officials having charge of the administration of civilian aviation policies will solve it once and for all.

END

She's Only 11

THE CAA reported the crash of an 11-year-old plane in which the pilot was killed. Given as the "probable reason" for the crash was the structural failure of an aileron due to the deterioration of wood structure—a hint for owners of old planes to check wooden frames.

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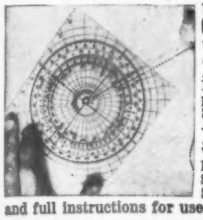

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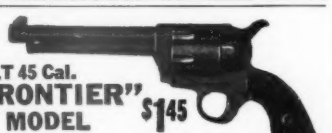

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BONDS BUY BOMBERS!

Some Soldiers Don't Shoot

(*Continued from page 63*)

chanic is one of the most highly skilled technicians in the aviation industry. Many of the students were watchmakers before they exchanged civilian dress for a uniform, and they are delighted with the assignment because it gives them a type of training that will be immensely valuable to them after the war.

All begin by learning the special skills and techniques required for this kind of work, and after the preliminary and general instruction in methods they are divided into specialized groups. One section is given intensive training on instruments of the gyroscopic type. Another group studies in elaborate detail the maintenance of electrical instruments. Still another section is taught how to overhaul and repair pressure operated instruments.

Upon graduation from the school they go back to their original Air Forces unit, perhaps destined for overseas duty, perhaps for assignment to instrument work at air bases in this country. They give new and important emphasis to the much-repeated statement that this is a war of specialists, and form a group whose job it is, in more than the usual sense, to "Keep 'Em Flying!"

END

I Learned About Flying

(*Continued from page 72*)

We straightened the axle and spokes in a bonfire and replaced them, trueing up the wheel. We spliced the ribs in the wing and repaired the fabric with part of a shirt, applied with gum from a tree and moistened with water to tighten it. We flew 1,000 miles with that patch on the wing.

We got the plane out and eventually reached Nairobi in Kenya Colony. A few weeks later the flight was abandoned, due to my getting too familiar with a propeller that was revolving at 1,800 r.p.m. I wound up in the hospital with a badly smashed left hand. The propeller finished up on my wall with a broken tip and a clock mounted in the center, and the flight finished in Nairobi.

The cause of the forced landing was due to our overlooking the important responsibility of checking the work done on the motors by the mechanics at Cairo and Khartoum. In both places they had neglected to clean the gauze covers on the oil vents. Sand had collected and had clogged them completely. This caused oil to be pumped through the propeller hub. Secondly, the bolts holding the cowling on the starboard engine had not been tightened and, through constant vibration, had loosened and fallen out causing the cowling to break loose.

Since then I never have taken any person's word that a plane is okay without thoroughly checking up myself. I did that once and I learned about flying from that.

END

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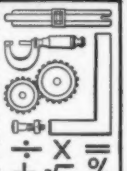

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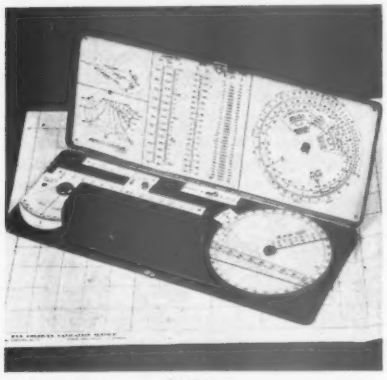

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Flight Test

(*Continued from page 61*)

any pickup at will and obtain a continuous record of that pickup. Such tests have been made at Vultee to record loads on a structural member that had been failing in flight. In plotting the curves of the loads on this member during buffeting encountered in a pullout, the average load of approximately 7,000 p.s.i. had been anticipated, but the load reversals of a magnitude of over 20,000 p.s.i. in tension and 30,000 p.s.i. in compression at a rate of 6,000 c.p.m. were entirely unexpected. Previously it had been impossible in the laboratory to reproduce failures in this member, but by applying load reversals as revealed by the Vultee Flight Recorder, laboratory reproductions of flight failures were accomplished.

END

At Deadline

(*Continued from page 8*)

amazed to see that several of the photographs in the set—they have few accurate silhouettes other than those borrowed from the RAF—were simply made from clippings out of FLYING. If nothing else, we would have been happy to have loaned them the original photographs to work from.

* * *

ONE of the phenomena of the war, we think, is the number of aviation people riding the railroads. We didn't realize it until we took to the rails—the first time in our life we have ever travelled cross-country on any public carrier other than an airline. Reason for the railroads' popularity is the airline priority system. Not that the priority passengers don't deserve preferential treatment, although we're told the "priority racket" was so abused that the regulations recently were completely rewritten.

We, and several other persons in aviation with whom we've discussed the matter, have been unceremoniously removed from airliners several times. Twice recently we not only held space on an airliner but were waiting in the lobby of the airline ticket office, bags aboard the car to the airport, only to be pushed off and left stranded at the last minute.

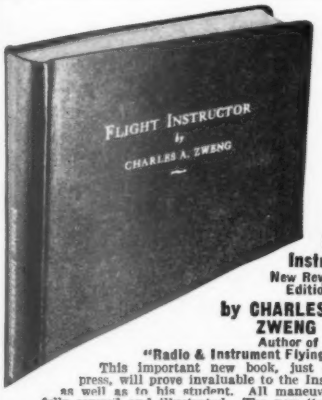
Fault does not lie with the airlines. Priorities are issued by the armed forces and are issued by them based on what they are told by the person requesting the priority.

Under the new regulations, the non-priority airline passenger is subject to removal by not only business men, but by any cargo that has to be moved fast.

Have a seat, piston!

MAX KARANT.

END



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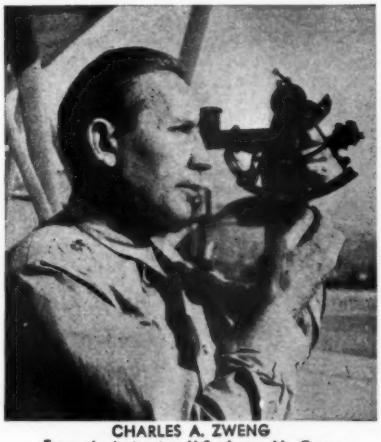

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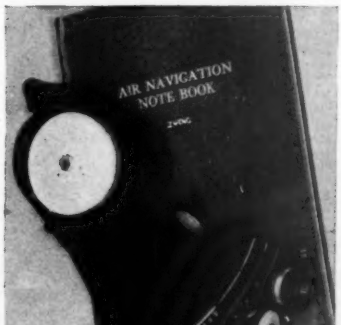

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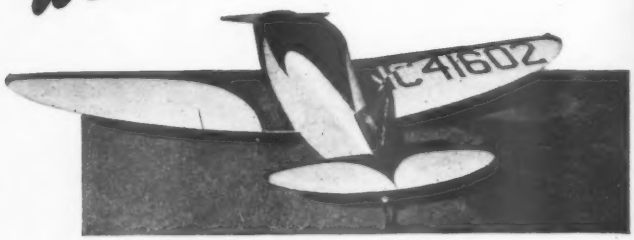

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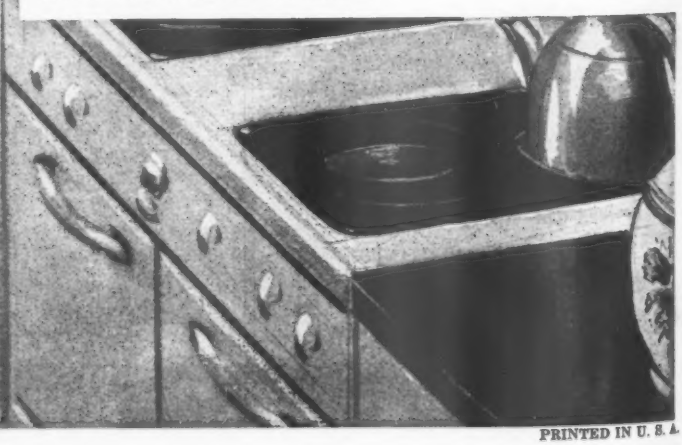

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